

Water Distribution Facilities Planning Study for *Stayton, Oregon*

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 **KELLER**
ASSOCIATES
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SECTION 1 - INTRODUCTION

1.1 Authorization

In 2002 the City of Stayton, Oregon contracted with Keller Associates, Inc. to prepare a Water Distribution Facilities Planning Study for the City.

1.2 Introduction

The City of Stayton is a rural community located approximately 17 miles southeast of Oregon's capital city, Salem. The area's economic base consists of agriculture and industry. The community also serves as a bedroom community for Salem, with a 15-20 minute commute each way.

The City is committed to providing the community with quality water and adequate fire protection for all residential, commercial and industrial areas. This master plan evaluates the existing system and makes recommendations for improvements and upgrades necessary to accommodate future conditions and City objectives for water supply, distribution and storage.

1.3 Related Studies

The City currently owns and operates its own water supply, storage and distribution facilities. The document *Water Supply and Treatment Facilities Planning Study* addresses water supply and treatment needs and recommendations.

As part of the master planning, Keller Associates also completed a *Water Management and Conservation Plan* which satisfies Oregon Administrative Rules 690-315 and 690-086. The *Water Management and Conservation Plan* contains four major elements including a water system description, a water conservation element, a water curtailment plan, and a water supply element.

In June 2004, Keller Associates also completed a *Water System Vulnerability Assessment* as required by the "Bioterrorism Preparedness and Response Act". The *Water System Vulnerability Assessment* identified water system vulnerabilities, and outlined improvements that will minimize vulnerabilities.

Keller Associates has also been commissioned to complete wastewater and storm drain master plans. Additionally, the City of Stayton has recently completed transportation, trails and parks master plans. The completion of these studies will enable the City to acquire necessary funding to implement critical improvements now and also make accommodations for future growth.



1.4 Scope

The scope of this document includes the following:

- Review Regulatory Requirements
 - Identify State and Federal requirements, including the Safe Drinking Water Act, Bioterrorism Preparedness and Response Act, Oregon Administrative Rules, and others which influence the management of the City's water system.
 - Prepare a Water Management and Conservation Plan.
- Characterize Existing and Projected Water Use
 - Compile and review the following information: study area boundaries, inventory of existing facilities and pipelines, type and amount of water consumption and production, existing and projected land use and populations.
 - Perform a water balance to compare total well production with water consumption, in order to define water system demands and non-revenue water losses.
 - Develop current water demands by use, and utilize these design criteria to develop future water demands.
- Water Transmission, Storage, and Distribution Criteria
 - Compile standards and recommendations for water storage, pressure requirements and fire protection.
- Assess Existing Transmission, Distribution and Storage System
 - Review the existing water system conditions, including an analysis of the following: system pressures, pressure zones, facility and pipe capacities, available fire protection, well supply, water storage, transmission, delivery and SCADA control.
 - Provide the City a schematic of the City water system.
 - Develop and calibrate a working computer water model of the City's water system. Evaluate system performance including



operating pressures, available fire protection, tank circulation, and finish booster pump operation with working water model.

- Water Transmission, Storage, and Distribution Improvement Plan
 - Investigate and evaluate alternatives that will address City planning goals. Review environmental impacts of each alternative.
 - Develop a plan of phased improvements to water transmission, storage, and distribution with their respective costs. Develop a system replacement program.
- Implementation
 - Prepare a Master Plan outlining costs for future facility needs, replacements and pipeline extensions. Develop an estimated schedule for capital improvements and a summary of all potential impacts on rates or funding sources.
- Report Preparation
 - Prepare a report with a copy submitted to the Oregon Department of Human Services, Drinking Water Division for review and approval.
- Public Participation, Presentations and Meetings

1.6 Acknowledgements

Keller Associates would like to acknowledge those that provided time and assistance in furnishing information for this report. A Technical Review Committee (TRC) was formed in order to facilitate communication and evaluation with the City. The TRC met on a regular basis to discuss project progress and findings. The following individuals were members of the TRC and were of particular assistance in developing this master plan: Stayton Public Works Director Mike Faught, Water Supervisor Tom Etzel, Water Treatment Plant Operator Bob Zeller, Engineering Technician Allan Drawson, and City consultants Ed Sigurdson and Steve Applegate.



SECTION 2 - WATER SYSTEM REQUIREMENTS

2.1 Study Area

The existing city limits of the City of Stayton encompass an area of approximately 1,768 acres between Highway 22, also known as Santiam Highway, and the North Santiam River. The study area corresponds to the urban growth boundary (UGB) which includes an additional 1,440 acres of land, for a total of 3,208 acres. The study area (UGB) represents the expected areas of growth and development. Figure 2.1 in Appendix A illustrates the city limits and the study area boundary (UGB).

2.2 Land Use

The City of Stayton includes lands designated as commercial general, commercial retail, industrial, industrial agriculture, industrial commercial, light industrial, interchange development, low, medium and high density residential, and public/semi-public zoning inside the city limits. Figure 2.2 in Appendix A graphically reflects the land use distribution adopted by the City. The table below summarizes the breakdown in acreage for each land use type.

Table 2.1
Existing Land Use Inside Stayton City Limits

Stayton		
Land Use	Acres	% of Total
Commercial General	104	6%
Commercial Retail	47	3%
Industrial Agriculture	60	3%
Industrial Commercial	17	1%
Light Industrial	320	18%
Low Density Res.	709	40%
Medium-High Density Res.	273	15%
Public and Semi-Public	238	13%
Total Acreage	1,768	

2.2.1 Future Land Use

Keller Associates worked with the technical review committee (TRC) and Stayton planning personnel in developing future land use outside the existing City Limits, but within the urban growth boundary (UGB). Future land uses assumed for this study are illustrated in Figure 2.4 in the Appendix A.



A corridor of light industrial use is expected along the west urban growth boundary of Stayton. Most of the remaining growth area is designated as low density residential with medium-high density residential areas scattered throughout. Some of the public lands correspond to potential areas identified by the City and school district as future school sites and parks.

The development densities for residential areas illustrated in Table 2.2 were developed as targets for future residential development based on consultation with City planners.

Table 2.2
Household Residential Densities

Low Density Residential (ERUs/ac)	Med-High Density Residential (ERUs/ac)	Household Size (people/ERU)
3.5	6	2.7

*ERU refers to the Equivalent Residential Unit

2.3 Population

The estimated 2003 population for the City of Stayton is approximately 7,300. Historical population in the City of Stayton and in Marion County retrieved from census data is shown in the following table.

Table 2.3
Stayton and Marion County Historical Population

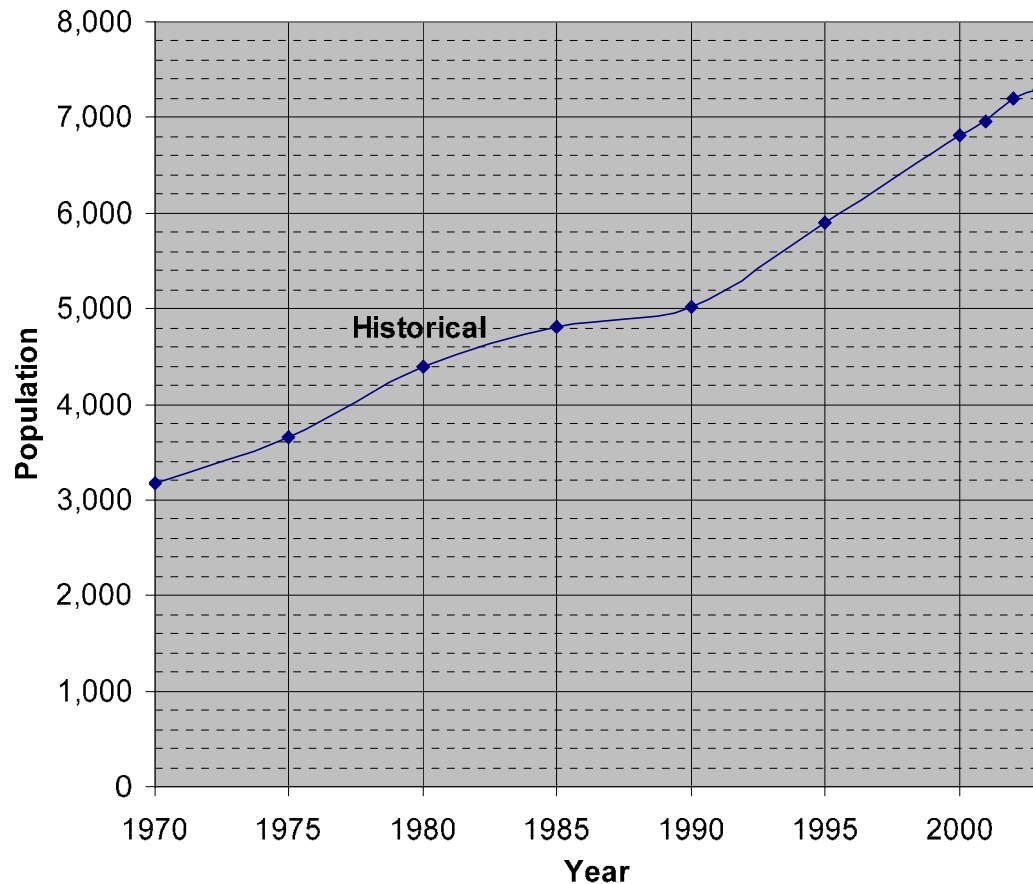
Year	Office of Economic Analysis, State of Oregon and US Census—Marion Co.	Stayton Population Census Data	Marion County Growth Rate	Stayton % of Marion County	Stayton Annual Growth Rate
1970	151,309	3,170		2.10%	
1975	171,700	3,650	2.56%	2.13%	2.86%
1980	204,692	4,396	3.58%	2.15%	3.79%
1985	213,019	4,815	0.80%	2.26%	1.84%
1990	228,483	5,011	1.41%	2.19%	0.80%
1995	260,600	5,907	2.34%	2.27%	3.34%
2000	284,834	6,816	1.06%	2.39%	2.90%

As can be seen from the preceding table, the annual growth rate in Stayton declined between 1980 and 1990 and then rose sharply after 1990. The average annual growth rate for Stayton was 3.34 % between 1990 and 1995 and 2.9%



between 1995 and 2000. The growth rate in Stayton has generally been higher than Marion County. Chart 3.1 illustrates historical population trends.

Chart 2.1
City of Stayton Historical Population



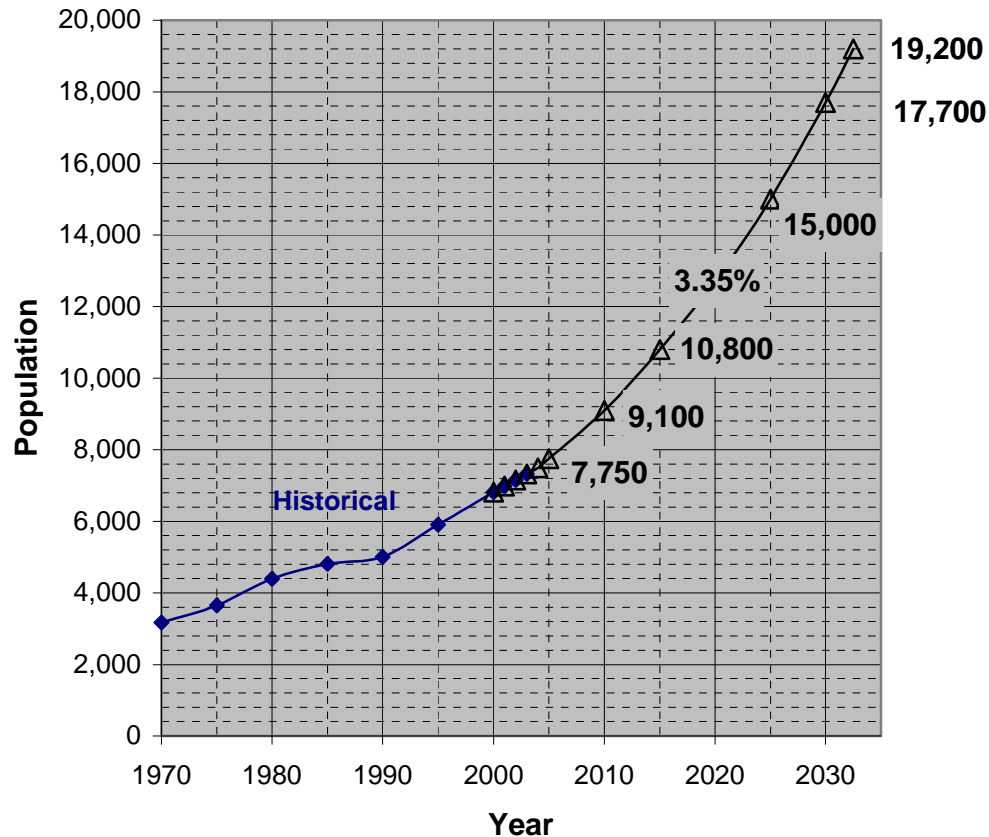
2.3.1 Population Projection

City population estimates from 2001 to 2004 were approximated using Stayton building permit information (refer to memorandum from Ed Sigurdson in Appendix B). Growth projections are based on a continued growth of 3.35%.

Build-out of the study area (UGB) using a growth rate of 3.35% will occur sometime around 2032.



Chart 2.2
City of Stayton Population Projections



2.4 Water Production

A summary of the City's adjusted historical water production and consumption was presented in the *Water Production/Use Summary Technical Memorandum* dated March 26, 2004. A copy of the memorandum is included for reference in Appendix B.

The main water source for the City is the Stayton Ditch. The Stayton Ditch is fed from the North Channel of the Santiam River via a diversion structure situated about 1 mile east of the water treatment plant site. The City's use of the Stayton Ditch is made possible through an interagency agreement with the Santiam Water Control District, which includes an annual use fee.

The Water Treatment Plant (WTP) also operates three shallow infiltration wells that are located adjacent to and between the canal and the North Santiam River. The wells supply supplemental water during peak demand and high turbidity events.



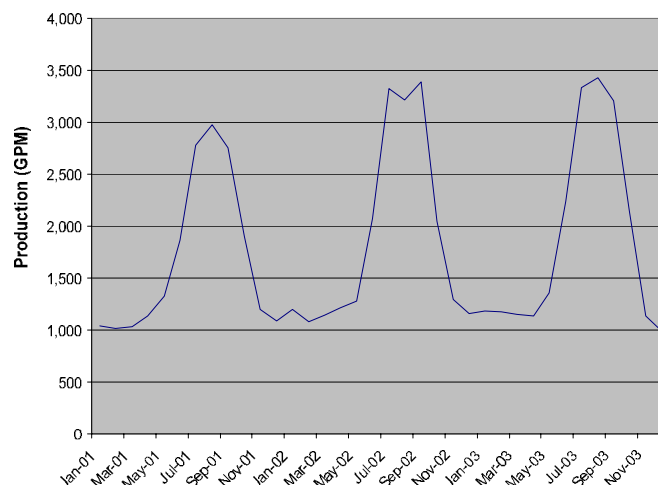
Water production data is recorded by a water meter at the finish booster station located near the water treatment plant. After completing multiple flow tests, it was determined that the flow meter at the finish booster station was inaccurate when the 200-hp pumps were operating. As a result, the original production data were adjusted to correct for the error in the water meter readings. The testing and adjustment process is described in much greater detail in the *Water Treatment Plant Meter Analysis Technical Memorandum* dated March 26, 2004 included in Appendix B. The data presented below reflect the corrected production results.

Water production has increased by nearly 12% from 2000 to 2003. This corresponds to an increase in the City's population during that period. Table 2.4 lists water production statistics for the past three years. Water production data for 2001-2003 were used to develop water demand conditions for Stayton's existing water users. These water demand conditions were used to evaluate the City's existing facilities and also to forecast future water demands.

Table 2.4
Stayton WTP Water Production

	Historical Water Production				
	2001 (MGD)	2002 (MGD)	2003 (MGD)	2001-03 Average (MGD)	2001-03 Average (GPM)
Average Day	2.42	2.70	2.71	2.61	1813
Peak Day	5.19	6.08	6.65	5.97	4146
Dry Weather (May-Oct)	3.26	3.68	3.77	3.57	2480
Wet Weather (Nov-Apr)	1.56	1.70	1.63	1.63	1132

Chart 2.3
Stayton Monthly Water Plant Production (2001-2003)



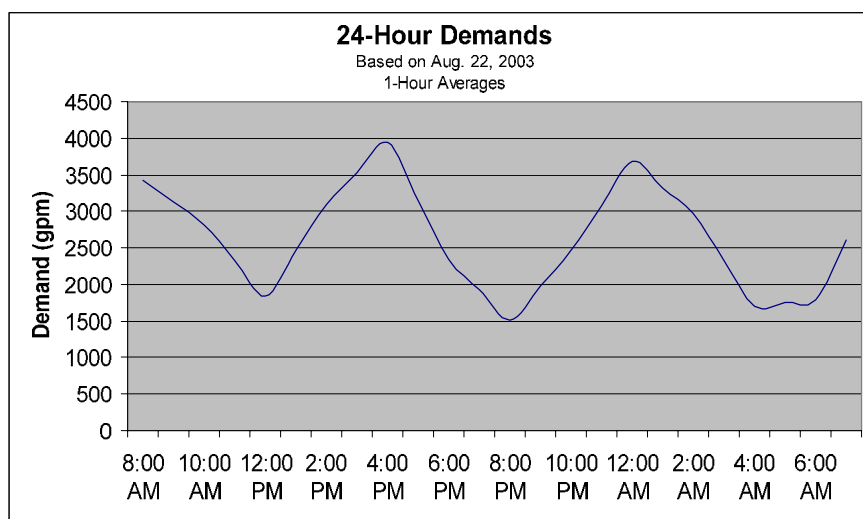
As illustrated in Chart 3.3, peak month flows correspond to the summer months (June through September) during which demands are more than double average annual demands. This peak in production is generally a result of irrigation and a peak in summer use from the City's largest water consumer, Norpac Foods, Inc. The processing of beans and corn creates a peak in Norpac Food's water demand from July through October.

2.4.1 Daily Demand Patterns

A 24-hour flow monitoring analysis was completed with the help of City personnel on August 22, 2003 to develop a 24-hour water demand pattern. This was done by recording flow meter readings at the finish, Regis and Pine Street booster stations; water levels at all of the City reservoirs; and meter readings for all of the Norpac water meters every hour. This data was then used to develop system water demands every hour. This analysis was done in August, which is a peak water demand period, because water demands are most critical during dry weather periods.

Chart 2.4 shows the 24-hour demand pattern for August 22, 2003. The average water demand for this day was 2630 gpm, which is slightly higher than the average dry weather demand. During this season, as seen in this chart, three peak demand periods occur. Peak demand periods occur around 8:00 am and 5:00 pm, which correlates to times before and after school and work. The third peak period occurs in the middle of the night (at about 1:00 am), which is likely created by large water demand processes observed at Norpac. The peak hour for this day (3950 GPM), which should represent typical dry weather periods, is about 1.5 times greater than the average day demand of 2630 gpm.

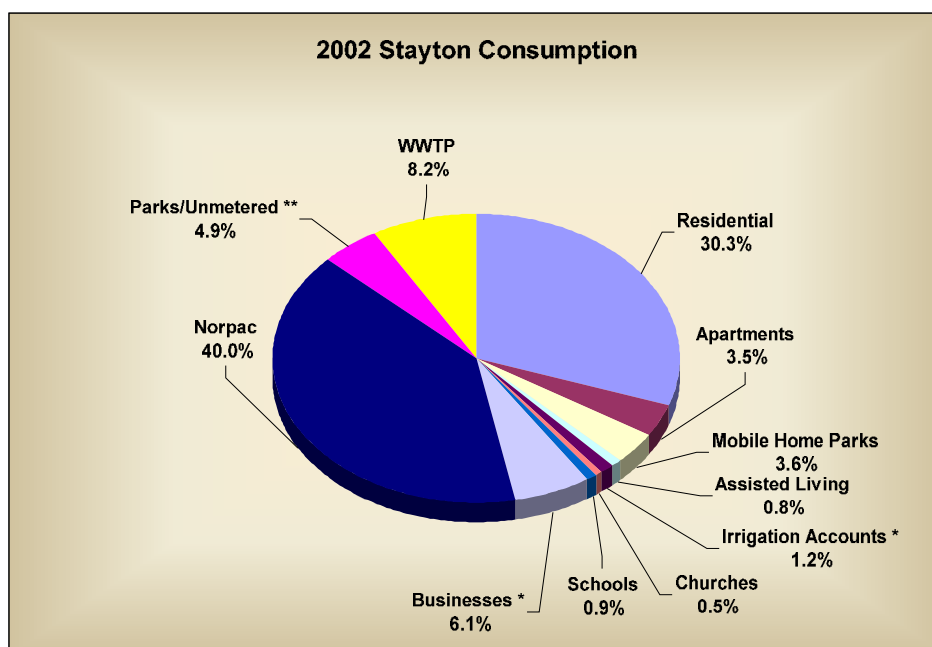
Chart 2.4
Stayton Summer 24-Hour Demand Curve



2.5 Water Consumption

Water users include single-residence homes, apartments, mobile home parks, assisted living centers, irrigation accounts, churches, schools, commercial users, and industrial water consumers. The industrial user, Norpac Foods, Inc., is the largest water consumer and accounts for approximately 42 percent of the annual water consumption. The general customer categories and their percentage of water use are illustrated in Chart 2.5 and Chart 2.6 for 2002 and 2003, respectively. In 2003, the City of Stayton service population included approximately 7,300 people.

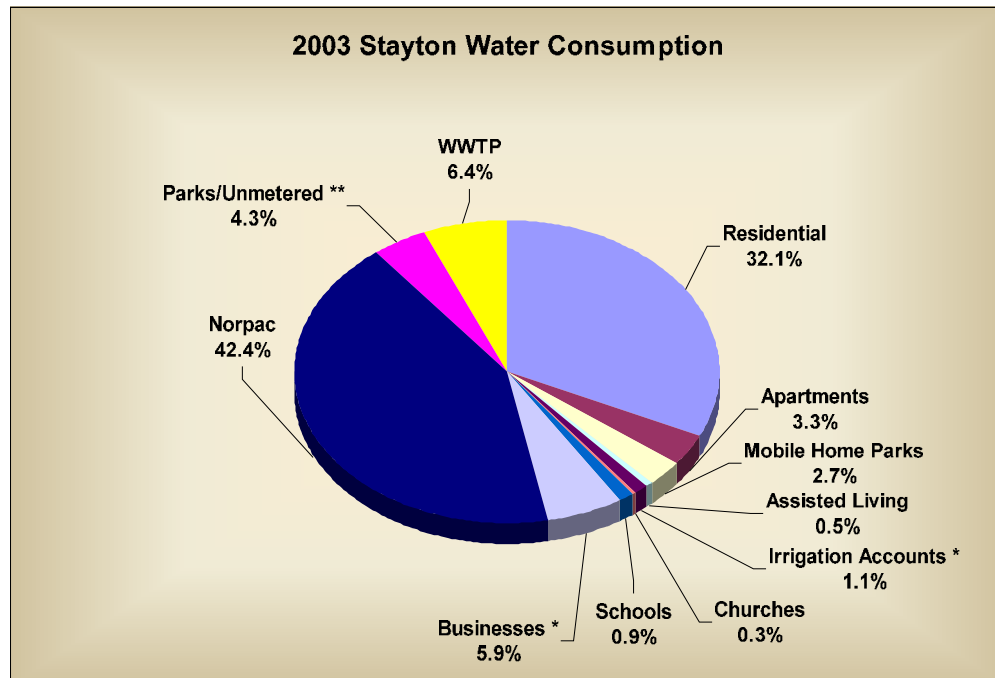
Chart 2.5
Water Use Statistics for 2002



* Irrigation and Business totals exclude Norpac's consumption



Chart 2.6
Water Use Statistics for 2003



* Irrigation and Business totals exclude Norpac's consumption

The “Residential” category for 2003 includes both rental and owner-occupied single-family residences, and accounts for 32% of the water use for the City. Norpac Foods, Inc. accounts for 42% of the total water consumption for the City. The “Parks/Unmetered” category includes the water used by the library, city hall, theatre, community center, cemetery, water plant, public works building, the pool, and the city parks. The Wastewater Treatment Plant (WWTP) uses approximately 6.4% of the total water provided in 2003.

2.5.1 Commercial and Industrial Use

Special consideration was given in accounting for the peak water users on the community water system. Because of their impact on operation of the water system, the top 30 water users were identified and their water consumption was analyzed. Table 3.7 lists the top 30 users and their associated total consumption, plus average month, winter and summer water consumption rates based on 2001-2002 consumption records. The top 30 users account for 59% of the annual total water consumption.

Norpac is by far the largest water user in Stayton and, as such, plays a central role in water planning, both in terms of infrastructure needs and overall water system budgeting. In recent years, Norpac implemented



water conservation. According to City staff, Norpac water demands are anticipated to hold steady. For planning purposes, Keller Associates has assured the Norpac's demands will not increase or decrease substantially.

Next to Norpac, the City's wastewater treatment plant is the next largest water consumer. A majority of the water at the wastewater treatment plant is used as rinse water for the filter press. Other water is used for plant flushing, irrigation, and domestic use. Other top water users include schools, mobile home parks, apartment complexes, and commercial and industrial establishments.

The WWTP could eliminate the use of potable water to clean the filter press by using the water from the biosolids instead, but this reuse program is not yet in operation. Other conservation or reuse measures could include using treated water for irrigation. However, this type of reuse would require chlorination. Since the plant uses UV to disinfect, substantial improvements would be required to enable water reuse for irrigation. Water reuse at the WWTP is an identified improvement on the WWTP capital improvement plan.



Table 2.5
Top 30 Water Users for Stayton, Oregon

User	Average Annual Usage (gallons)	GPM			
		Peak Month	Average	Summer	Winter
Norpac	265,186,000	1,746.46	504.53	839.51	93.77
WWTP *	54,778,793	132.01	104.22	112.10	107.99
Oak Estates Home	22,073,500	72.70	42.00	54.52	39.46
Philips Products 57	7,836,500	20.66	14.91	18.98	8.97
Boulders MH Park	5,455,000	17.42	10.38	12.62	10.13
Stayton Union High School	3,579,500	13.72	6.81	8.87	4.99
Wolf Ridge Apartments	3,570,500	14.41	6.79	8.53	5.49
City Parks	3,503,700	243.31	6.67	243	0.00
Santiam Memorial Hospital	3,086,500	13.09	5.87	8.70	3.54
Pioneer Apartments	2,975,000	6.84	5.66	6.14	5.70
Shell Station	2,579,500	8.54	4.91	6.57	3.05
Safeway Stores	2,407,500	6.42	4.58	5.03	3.68
Lakeside Assisted Living	2,377,500	10.56	4.52	7.10	2.58
East Santiam Manor	2,097,500	7.33	3.99	2.61	3.98
Rivertown Apartments	2,052,000	4.50	3.90	3.92	4.12
Stayton Middle School	1,906,500	11.64	3.63	7.13	1.15
Summit Window	1,843,000	5.81	3.51	4.74	2.41
Stayton Elder Manor	1,810,500	9.02	3.44	7.08	1.35
Marion Co. Housing	1,792,000	17.74	3.41	4.93	1.25
Santiam Cleanery Service	1,698,500	3.64	3.23	3.21	3.06
Northridge Apartments	1,439,000	8.81	2.74	7.47	0.12
Fir Crest Village	1,319,500	3.44	2.51	2.95	2.15
Regis High School	1,214,500	7.52	2.31	5.11	0.91
Community Center/Library	987,600	68.58	1.88	69	1.88
Dairy Queen	888,000	4.42	1.69	2.97	0.65
Arco AM/PM	870,500	4.44	1.66	3.43	0.27
McDonalds	859,000	4.55	1.63	2.37	0.70
Cemetary	768,000	25.00	1.46	25	0.00
Princeton Property Mgt.	715,000	2.15	1.36	1.54	1.13
Trus Joist Corp	698,500	1.93	1.33	1.54	1.26
Slayden Construction	692,500	5.01	1.32	2.95	0.23
Roth's IGA	658,500	1.55	1.25	1.38	1.19
WTP Irrigation	587,400	40.79	1.12	40.79	0.00
A&W Drive In	522,000	1.67	0.99	1.27	0.75
Ixtapa	497,000	1.19	0.95	1.05	0.96
Karsten Co.	273,500	1.04	0.52	0.58	0.18
TOTAL TOP USER CONSUMPTION					
		405,599,993	2,548	772	1,535
% of TOTAL WATER CONSUMPTION		59.2%	81.8%	59.2%	81.3%
				81.3%	28.1%



Notes:

- 1) Summer includes June-August.
- 2) Winter includes December of the previous year and January through February.
- 3) Peak Month is the average usage during the peak month.
- 4) Domestic and Irrigation meters for each user are included in the calculations.
- 5) Total water consumption was adjusted to include unmetered water usage at parks and unbilled, metered usage at the Wastewater Treatment Plant.
- 6) The peak month flow for the WWTP is actually a peak week flow.
- 7) Total water consumption represents 2002 data.

2.6 Water Balance

Table 2.6 compares reported water production data to consumption data. Water consumption for unmetered users such as the City Parks was approximated and included in the water consumption data reported below. The difference between water production and water consumption represents the amount of system water loss.

Based on this data, water losses account for 24 to 33% of all water leaving the water treatment plant. It should be noted that the water loss quantified below includes only water lost somewhere between the finish booster station and the customer. Additional water loss may occur within the water treatment plant as discussed in the *Stayton Water Supply and Treatment Facilities Planning Study* report.

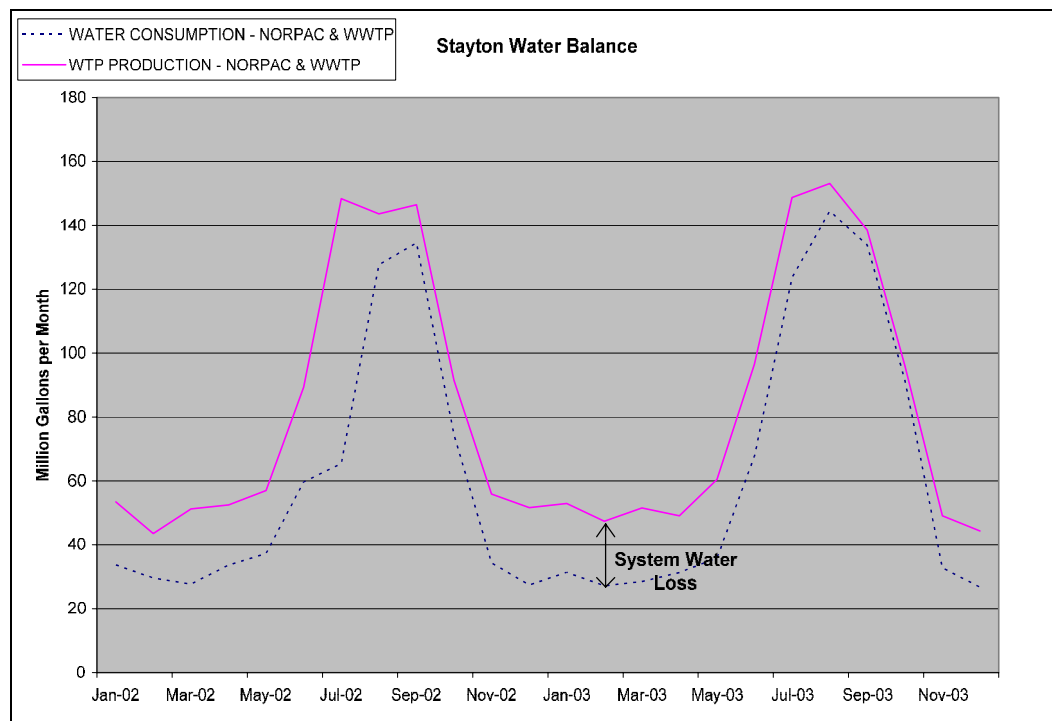
Table 2.6
System Water Loss Summary

	2001	2002	2003
Water Consumption (gals)	616,612,508	685,393,053	774,859,053
Water Production (gals)	883,414,920	984,453,840	987,805,020
System Losses (%)	30.2%	30.4%	21.6%

For additional comparisons purposes, Chart 3.7 graphically illustrates the comparisons between water production and consumption. Because Norpac and the WWTP are such large water users and there is a lag between water consumption data versus water production data (billing cycle), Norpac and the WWTP were excluded from these comparisons.



Chart 2.7
Stayton Water Balance



Factors that could contribute to system water loss include:

- Inaccurate water meters. Generally, water meters underestimate flows as they age. Based on discussions with water meter manufacturers, a residential water meter in a treated surface water system (generally soft, non-corrosive water) should accurately meter for 15-20 years. According to City staff, most of the flow meters have been installed since the 1970s. Based on housing records from census data, approximately 1,100 meters (41%) could be more than 20 years old and have likely been in operation beyond their period of accuracy.
- Although meter accuracy generally declines over time, Tom Etzel tested 30 random meters and determined that all but one of the meters was within 4% accuracy, and 17 of the 30 were within 2%. All but two of the meters that were tested pre-dated the touch read meters. Of the 30 meters analyzed by Tom, the “older” meters were generally accurate. Further testing is needed to determine if this trend is consistent with all the “older” meters throughout town.
- Leaky pipelines and services. This is believed to be the largest source of water loss as evidenced by the relatively constant year-round deficiency between what is pumped into the system and what is metered out of the system. The structural integrity of water pipelines and services naturally



degrades over time. Pipeline deterioration, improper installation procedures, and other factors can also create leaks. Pipes constructed with certain materials, including steel and asbestos cement, are generally more susceptible to leaks. Fifty-seven percent (57%) of the water lines in the Stayton water system are steel or asbestos cement. One extreme example of a leaky pipeline section is the two-block section of steel pipe located on Burnett Street near the public pool. Thirteen separate spot repairs have been made on this section of pipeline within the last several years. Another example of a leaky pipeline section is the 6-inch steel water line on Elwood Street.

- Unaccounted water use. Since water loss represents the difference between the water produced and the water consumed, water consumption that is not metered increases the apparent water loss. Occasionally, cities use water for city purposes like street cleaning, public buildings, pools, fire protection, and line flushing that is not metered. Keller Associates has accounted for known unmetered water uses like the public buildings, parks, and cemetery in the water balance calculations presented above. However, there are likely other unmetered water uses that add to the water loss, such as street cleaning, line flushing, and others. Keller Associates recommends that all water uses be metered where possible, regardless of whether or not they are invoiced.

Division 86 in the Oregon Administrative Rules requires any water supplier with water loss greater than 10% to establish a leak detection program. Division 86 further requires a leak repair or line replacement program for water suppliers with water loss greater than 15%. **Given the City's system loss, Stayton is required to establish both leak detection and leak repair programs.** These programs are described in Chapter 7.

It is to the City's advantage to minimize system water loss by addressing the potential problems above. System loss represents water the City pays to pump and treat but for which it is not reimbursed through water utility rates. Water loss represents a loss in potential income and a valuable natural resource.

Keller Associates suggests the City implement the following recommendations to reduce the system water loss.

- Begin a flow meter calibration and replacement program. By replacing 125 meters every year, the residential water meters will be replaced every 20 years. We have identified the priority areas for the meter replacement program in Figure 7.1. Part of the motivation in implementing a meter replacement program is also to switch to a radio read system.
- As part of the replacement program, Keller Associates recommends that the old meters be tested for accuracy. The accuracy versus age of the meters will be tracked in order to determine if a correlation between age and accuracy can be drawn. In addition, this program would attempt to quantify actual system



loss versus inaccuracies in the meter. It is recommended that, at a minimum, a set of representative meters in an area be tested every 5 years.

- Because of the high volume of water demand from Norpac, a faulty Norpac meter could result in a large unaccounted water loss and lost revenue. Therefore, it is recommended that the Norpac water meters be tested at least annually.
- Complete a leak detection study. Special attention should be given to those pipes constructed with steel and asbestos cement (AC) because they are generally more susceptible to leak problems (See Figure 4.2). The schedule of the leak detection program should also reflect the age of the pipe, with attention given to the older pipes first. A few large leaks could account for much of the unaccounted water usage.
- Develop a pipe replacement program based on the results of the leak detection study. Coordinate pipeline replacement projects with street improvements wherever possible to minimize costs.

2.7 Water Demand Projections

Water demands were calculated by adding the existing water usage recorded at the WTP and future demands projected for currently undeveloped land inside the Stayton study area. In an effort to project future water demands, the existing water usage was categorized into residential, non-residential, Norpac, and water loss. The non-residential category includes commercial, industry excluding Norpac, WWTP consumption, and public water demand. For comparative purposes, the demand for each of these categories was averaged over the Stayton population so demands could be compared and projected on a per capita basis.

Table 2.8 summarizes the demand for each category in gallons per capita per day. The severity of the system water loss is apparent by comparing the residential demand and the water loss. On an average day, the same amount of water used by the entire residential sector is lost from the system. The non-residential water demand stays fairly constant on a seasonal basis, averaging out to be about 46 gpcd. Norpac uses the largest percentage of water in comparison to the other categories.



Table 2.7
Existing Flow Summary

<i>Yearly Statistics</i>	Existing Demands (MGD)	Existing Demands Per Capita				
		Total System ⁽¹⁾ (gpcd)	Residential Only (gpcd)	Non-Residential (gpcd) ⁽²⁾	Norpac (gpcd)	Water Loss (gpcd)
Average Day	2.71	371	106	46	114	106
Peak Day	6.50	890	N/A	N/A	N/A	N/A
Dry Weather (May-Oct)	3.75	514	147	56	197	113
Wet Weather (Nov-Apr)	1.65	226	64	35	29	97

Notes:

(1) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(2) Non-residential flow per capita per day excludes Norpac Demand.

Future system demands were generated by adding the existing system demands to the additional water demand created by new development. The demands assumed for new development are presented in Table 2.8. The average day demand for new development is based on 210 gpcd (106 gpcd residential + 45 commercial/public + 50 industrial + 5% water loss).

Future water projections assume existing demands remain constant for existing development. This provides for some conservatism in future projections if the City pursues an aggressive leak detection and removal program. The projected demands for 2015, 2025, and build-out are summarized in Table 2.8.



Table 2.8
Water Demand Projections

Yearly Statistics	Evaluation Flows in MGD				
	New Development (gpcd) ⁽³⁾	2003 Demands (MGD) ⁽²⁾	2015 Flow (MGD)	2025 Flow (MGD)	Build-out Flow (MGD)
Stayton Population ⁽¹⁾	N/A	7,300	10,800	15,000	19,200
Average Day	210	2.71	3.45	4.33	5.20
Peak Day ⁽⁴⁾	500	6.50	8.25	10.35	12.44
Dry Weather (May-Oct)	270	3.75	4.70	5.83	6.96
Wet Weather (Nov-Apr)	160	1.65	2.21	2.88	3.55

Notes:

(1) Population projections assume a 3.35% growth rate.

(2) Existing system includes residential and non-residential demands. Future demands from the existing system users are assumed to remain constant.

(3) New development includes residential and non-residential flows plus 5% water loss (which is substantially less than observed in the existing system). Some additional industrial demand (50 gpcd) but not to the magnitude of Norpac, was also assumed. Actual future demands will be a function of the type of future industry that locates within Stayton.

(4) In determining peak day demand for new development, a peak day factor (peak day divided by average day) of 2.4 was used. This is consistent with the existing peak day factor ($890/371 = 2.4$).

The projected 2025 peak day demand of 10.35 MGD. When the Stayton urban growth boundary is at build-out, peak day demands are projected to be about 12.45 MGD, which is still less than the existing 17.62 MGD summer water right.

The existing treatment capacity is the limiting factor for growth. Additional supply and treatment capacity will be required to meet projected demands. Additional discussion on treatment plant capacity can be found in the *Stayton Water Supply and Treatment Facilities Planning Study* report.



SECTION 3 - DESIGN CRITERIA

3.1 General

This section summarizes the design criteria and regulatory requirements as they pertain to the City's water distribution system.

3.2 Water Storage

Keller Associates recommends a minimum storage capacity equal to the operational, peaking and fire protection storage.

- *Operational Storage.* Operational storage is the volume of water drained from the reservoirs during normal operation before the wells begin pumping to refill the reservoirs. The operational storage recommended for Stayton is approximately 1,040,000 gallons.
- *Peaking Storage.* Peaking storage refers to the additional storage required to meet peak hour demands while pumping at a constant rate from the wells. The needed peaking storage is expected to increase from the existing 350,000 gallons required to 670,000 gallons at build-out.
- *Fire Protection Storage.* City fire protection needs require 1,080,000 gallons reserved to fight a 4,500 gpm fire for 4 hours.
- *Emergency Storage.* Keller Associates recommends that the City consider securing additional emergency storage above the operating and fire needs to allow for extenuating circumstances such as extended power outages or other unanticipated circumstances.

Stayton personnel have also expressed an interest in acquiring additional emergency storage to meet average water demands (less Norpac) for 3 days. This would equal 5.4 MG of emergency storage now and 13.08 MG at build-out. Of course, this amount could be reduced by backup or alternative water supply capabilities (i.e. a deep well).

3.3 Distribution System

3.3.1 System Pressures

The Oregon Administrative Rules requires public water systems to maintain a minimum system pressure of 20 psi during peak hour and fire flow conditions to prevent contamination of the drinking water. Normal operating pressures should range between 60 and 80 psi, but not less than 35 psi.



3.3.2 Sizing Future Pipelines

There are many undeveloped areas surrounding Stayton, which will require water pipelines be extended to serve them as the community grows and expands. In sizing these new pipelines the principal design criterion is that the pipelines be large enough to deliver peak hour and fire protection demands while maintaining adequate system pressures. The following are additional design criteria that are recommended when extending new waterlines to these areas:

- The distribution system must be capable of delivering fire demands while maintaining 20 psi residual pressure throughout the system
- Fire demands for residential areas are between 1,000 and 1,500 gpm.
- Fire demands for commercial and industrial areas are 2,500+ gpm.
- Build-out demands should be considered in sizing new waterlines, due to the potential 75+ year life of the pipe.
- Future demands per capita are expected to be less than the existing water consumption per capita. This is consistent with the City's goal of encouraging water conservation.
- As a general rule, Keller Associates recommends placing 12-inch pipelines on the mile and 10-inch pipelines on the half mile.

In preparing the Master Plan, some pipelines may be slightly oversized to allow for flexibility in future land use, and in how and where future development occurs.

3.3.3 Water Meters

Manufacturers recommend that residential water meters be replaced every 15-20 years. State requirements in the Oregon Administrative Rules 690-086 require that water suppliers that are not fully metered implement a plan to become fully metered in the next five years. A fully metered system meters all sources and consumers.

3.4 Fire Protection

The Stayton Fire Department depends upon the City's potable water supply drawn from the fire hydrants on the City distribution system to fight fires. Providing adequate fire protection in residential, commercial and industrial zones often



governs distribution pipeline sizes, pipe looping requirements, and reservoir storage needs.

The International Fire Code states the minimum fire flow requirements for one and two family dwellings having a fire area less than 3,600 square feet is 1,000 gpm for a duration of two hours. Homes larger than 3,600 square feet require 1,500 gpm fire protection. Larger buildings, such as the Stayton High School, Regis High School, Junior High School, and the hospital may require fire flows as high as 4,500 gpm for a duration of 4 hours, dependent upon size, construction material type, and if the buildings are equipped with sprinklers.

3.5 Water Quality

Water systems in Oregon are required to maintain a minimum chlorine residual of 0.2 mg/L in the distribution system. This residual will eliminate the growth of bacteria and other contaminants throughout the distribution system.



SECTION 4 - EXISTING FACILITIES' CONDITION AND EVALUATION

4.1 General

This section summarizes existing storage and booster facility conditions. In addition, an overview of the water distribution system conditions is presented. Additional computer analysis of the water distribution system is presented in Section 6.

4.2 Water Storage Facilities

The City of Stayton has four water reservoirs, which include Schedule “M”, Pine Street, Regis, and the Water Treatment Plant (WTP) Clear Well. An overview for each facility is provided below.

4.2.1 Schedule “M” Reservoir

The Schedule “M” reservoir was constructed in 1971 for peaking needs and backup supply for the cannery. It is a 1.0 MG welded steel reservoir with a diameter and height of 65 feet and 40 feet, respectively. Prior to Schedule “M”, the cannery had a pump that pulled water directly from the Salem water supply line.



Located at the reservoir site is a booster station that is discussed in Section 5.3.3. Before completion of the Pine Street reservoir, the Schedule “M” booster station would run almost every day.

The Schedule “M” reservoir has not been painted in at least 12 years. The interior was inspected by the City approximately 9 years ago and was found to be clean, in good shape, and void of rust.

Under normal operation, flow enters the reservoir from the City’s distribution system through a pressure-reducing valve. This requires the water to be pumped again to serve the distribution system. During emergency events, flow could also enter the reservoir from the Salem pipeline.

Approximately 30 gpm of water is wasted continuously from the reservoir to provide circulation through the tank. Pipeline improvements, water



looping projects and the completion of the Pine Street reservoir has marginalized any fire protection benefit provided by the Schedule “M” reservoir. Redundancy is the primary contribution that Schedule “M” makes to the City’s existing water system. Keller Associates recommends that this reservoir be relocated to the water treatment plant (WTP) site when additional storage is required for chlorine contact time at the WTP. This is discussed in more detail in the water treatment plant analysis.

4.2.2 Pine Street Reservoir

The Pine Street reservoir and booster station are located on the east side of Stayton. The facility consists of a fenced site with a 5.0 MG concrete reservoir and a building housing the booster pumps. The facilities at this site were constructed in 1995. The City uses the Pine Street reservoir during the summer to meet domestic demands and fire protection needs.



The Pine Street reservoir is about 40 feet high and 148 feet in diameter. An access ladder located on the south side of the reservoir provides access to the top. The water supply line enters the bottom of the reservoir from the south side through a check valve. A line tap into the effluent pipe runs westward to the booster pump station. The effluent line acts as the suction pipe for the booster pumps.

The reservoir is a DYK prestressed concrete tank with a wire wrap structure and spray-on mortar on the outside. The mortar is probably about ½ to ¾ inch thick (typical of gunite mortar coatings used on this type of tank). The reservoir has a gravel roof coating over the concrete structural cover.

The outside of the reservoir has cracking of the entire mortar. Crack separation is moderate to wide. The cracking is extensive in a random map pattern, which is typical of shrinkage cracks in the mortar due to moisture drying during the curing process of the mortar. These cracks are easier to see after a rain because the moisture next to the cracks amplifies the crack location.

Moisture intrusion into the cracks has caused efflorescence in many places, but the efflorescence was not extensive. The efflorescence is occurring due to moisture being trapped in the cracks, and leaching the salts from the mortar mix.



Sounding of the surface indicates there is some delamination occurring between the mortar and the underlying concrete and wire wrap. Although some delamination has occurred, there is not extensive rust staining on the outside from the interior bars or wire wrap at this time.

The interior of this reservoir has not been inspected since its construction. The size of this reservoir causes some problems for the city. During the winter months, low water consumption creates issues with maintenance of chlorine residual and stagnation of the water in the reservoir. In order to maintain a 0.2 mg/l chlorine residual in the reservoir, the city feeds 0.7 milligrams of chlorine at the treatment plant.

The city would like to be able to do something different to avoid having to feed excessive chlorine at the treatment plant. One possibility is to add a chlorination system at the Pine Street Reservoir to keep the chlorine level up at that point without having to add high chlorine at the water treatment plant. A less expensive alternative involves increasing the storage dedicated for operations. This can be accomplished by adjusting control set points to fluxuate the tank levels and increasing pump run times during periods of low system demands.

Currently, the Pine Street reservoir levels are used to control the on/off set points for the pumps in the finish booster station at the water treatment plant.

4.2.3 Regis Street Reservoir

Reservoir. The Regis Street reservoir was constructed in 1971. It is a 0.4 MG welded steel reservoir with a diameter and height of 31 feet and 80 feet, respectively. The inside of the tank has never been painted. The exterior of the reservoir was last repainted in 1995. Located at the reservoir site is a booster station that is discussed in Section 4.3.3.



The reservoir has a steel bottom plate that is resting on a concrete foundation. There are locations where hold-downs have been welded to the shell and extend down into the foundation. The anchors are apparently embedded in the foundation, since there are no anchor bolts showing above the top of the foundation. The hold-downs are likely used to prevent overturning from wind or seismic forces on the stand pipe.

The bottom plate on the concrete foundation is stained by considerable rust along the bottom due to moisture intrusion and water standing at the base of the reservoir. The concrete foundation was cast with the top level so water does not drain away from the tank. Water stands near the edge of the plate and accelerates the rust. There was a mastic seal along the joint between the steel and the concrete, but the seal appears to have failed a long time ago.

No one is aware of a case over the past twenty-two years where the interior of the tank was inspected. The reservoir is due to have the inside inspected either by dry or wet inspection.

Two cell phone companies have cell equipment on the Regis tank. A number of years ago, Sprint installed a cell communication system at the top of the stand pipe with the cable running down the stand pipe and across the racks on the ground. Cable trays and other communication facilities are located next to the pump station. The cell system apparently has a lightning arrester ground system on the antenna, since there is a ground wire in the cable bank coming down the stand pipe. The ground wire to the system is grounded at the foundation, and the cable trays are all grounded at the connection of the cable tray mounting into the foundations. Apparently this whole system grounds the stand pipe as well as the cell communication system.

There is an impressed current corrosion system on the reservoir. When last tested a few years ago, it was not working.

Appurtenances. The valve house next to the reservoir consists of a small block building with a roof. The valve house contains an altitude valve that shuts off when the reservoir reaches full, controlling the water level in the reservoir. On the south side of the reservoir, there is an overflow pipe coming out the top of the reservoir that spills on the ground below in the event of an overflow. There is no sign of any past overflow from the reservoir ever reaching the ground below the reservoir overflow, so apparently the altitude valve works.

A drain valve was installed a number of years ago in the bottom of the reservoir on the north side. The drain consists of a 4-inch steel pipe welded into the reservoir shell, with a gate valve mounted on the stub out. There is a provision to hook a hose on the drain pipe to take water to waste at some location away from the reservoir.

The piping for the reservoir passes through the yard and connects to the water main in Regis Street. (In the past, an 8-inch valved bypass line was connected to the suction and discharge of the booster station in an attempt to eliminate the need for the booster station. However, the bypass was not



successful and the bypass line is not used.) Water flows through the booster station from the main supply line that comes from the treatment plant. The discharge of the booster station goes to the upper pressure service area distribution system in Regis Street.

Summary. Pipeline improvements, water looping projects and the completion of the Pine Street reservoir has marginalized the fire protection benefit provided by the Regis reservoir. Redundancy is the primary contribution Regis reservoir makes to the City's water system. It provides redundant storage capacity, minimal fire protection, and a redundant facility to control the finish booster station if Pine Street is off-line. It is believed that residence times during winter months may be 20 days or more.

Keller Associates recommends that the tank be maintained until 2020 or 2025. Refurbishing is recommended now and will include repair of the base plate and anchor bolts, repairing and modifications to the foundation.

4.2.4 Clear Well at the WTP

The Clear Well at the WTP was constructed in 1971. It is a 0.5 MG welded steel reservoir with a diameter and height of 53 feet and 30 feet, respectively. A comprehensive discussion is presented in a separate document as part of the water treatment plant evaluation.

4.3 Booster Stations

The City of Stayton currently has four booster station facilities. Both the finish and Schedule "M" booster stations supply water to the Pine and Regis reservoirs and lower pressure zone. The Regis and Pine Street booster stations draw water from the lower pressure zone and service the upper pressure zone. With the exception of the finish booster station, each of these booster stations will be discussed below. A comprehensive discussion of the finish booster station is presented in a separate document as part of the water treatment plant evaluation.

4.3.1 Schedule "M" Booster Station and Salem Inter-tie

The Schedule "M" booster station was constructed in 1971 in order to improve fire protection to Norpac and surrounding areas. The booster station includes both an electric and diesel-powered pump that can produce approximately 3125 gpm and 3225 gpm at 72 psi and 68 psi, respectively (based on pump tests



conducted on June 3, 2004). Pumps can either withdraw water from the adjacent reservoir or from the inter-tie with Salem. The booster station is controlled with the City's SCADA system, but can be operated manually if necessary.

According to City personnel, the pumps are in decent condition, and the control valve was recently rehabilitated. However, the electrical and controls need to be upgraded if the booster station is going to continue to be used. The Schedule "M" booster station facilities are old, which makes replacement and repair costs high. The age of the system also makes the system less reliable.



Also located at the reservoir site is an inter-tie with the City of Salem, managed under an intergovernmental Mutual Water Agreement with Salem. An 18-inch pipeline connects Stayton's Schedule "M" booster station and the 54-inch transmission line that feeds the City of Salem. Typical pressure in the Salem pipeline is approximately 23 psi. Flow from Salem to Stayton must pass through a double check valve. The check valves can be manually opened to allow flow from Stayton to Salem in the event of an emergency (which has occurred in the past). The City of Stayton used the inter-tie in December 2004 during the installation of the baffle curtains in the City's clear well.

The primary benefits the Schedule "M" booster station provides to the system are redundancy and the inter-tie with Salem. The Schedule "M" booster station can provide the City's average day water demands, with the finish booster station off-line, even at build-out. The gas-powered pump at Schedule "M" could also meet the City's winter water demands in the event of a City-wide power failure. Keller Associates recommends that the Schedule "M" booster station not be abandoned without relocating the inter-tie with Salem to the water treatment plant and equipping the finish booster station with standby power.

4.3.2 Pine Street Booster Station

The Pine Street booster station was constructed in 1995. It includes a 3000-gallon pressure tank and three can-type pumps, with provisions to add two



additional pumps.

Booster Pumps. The booster station has five pump setting locations, with three pumps installed. There are two demand pumps installed, and space for a third. The third demand pump will be installed when development in the area requires additional pumping from the booster station. The two demand pumps currently installed are 7.5 hp and 10 hp. The fire pump arrangement has space for two pumps, with one 15 hp currently installed.



All five pump mounting locations have inlet piping connected to a common manifold that runs along the north side of the pump station. The pumps are can-set submersible pumps with the suction pipe connection at the top of the can. The discharges are out to the south through the floor.

The fire pumps are connected together and discharge to the main near the street. The demand pumps are connected together into the hydropneumatic tank. They are piped out through a valve to the water main in Pine Street south of the booster station.

There have been some problems with the booster pumps overheating. The cause of the overheating is believed to result from two things—inadequate flow and a pipe arrangement that does not encourage flow around the motor. The submersible pumps require flow through the pumps to cool the motor. Additionally, the pressure on the system is such that even when the 7.5 hp pump is running, with low demands and other pumps in the system running, there is little or no flow from the 7.5 hp pump.

Flow Meter. The flow meter, located in the suction manifold between the fire pumps and the demand pumps, is an inline type propeller meter with a magnetic drive and register head. The meter is located so the flow through the demand pumps goes through the flow meter but the flow through the fire pumps does not.

The operators of the system indicate the meter has erratic flow indication. When the 7.5 hp pump (Pump No. 1) is started, the flow meter stays on zero except for an occasional movement of the needle. The 10 hp pump causes the flow meter to bounce from 0 to 200 gpm, and flutter around that range. With the 10 hp pump running and the flow meter fluctuating, a noise comes from the meter sounding like a mechanical device catching –



clicking – rubbing. There has not been any work done on the meter to determine the cause of the noises.

Hydropneumatic Tank. The hydropneumatic tank is a steel tank, 6 feet in diameter and 13-½ feet long, in a horizontal configuration. It's purpose is to provide surge protection and a small storage volume to facilitate the on / off operations of the pumps. A small air compressor mounted on the wall next to the tank supplies air to the tank. The capacity of the air compressor is small, but the air demand is also low. It appears that there is a level control probe and a pressure switch that are supposed to keep the water level in the tank within certain operating limits.



There have been problems in the past with the hydropneumatic tank getting waterlogged. City personnel have added a glass sight tube to the outside of the hydropneumatic tank to indicate the water level in the tank. The water level in the tank currently runs about 22 inches below the top of the tank. To prevent waterlogging, the maintenance crew goes out three or four times per year and uses the manual drain to remove some of the water from the tank.

Malfunctioning of the level control system is probably the source of the hydropneumatic tank waterlogging. The level controls in the top of the tank are apparently not working properly to control the water level in the tank.

Control System. The pumps are controlled from mercury pressure switches. The switches are set to turn the pumps on at specified low pressures.



There is also a telemetry panel in the booster station to send a signal to the main water treatment plant to indicate the water level in the 5.0 MG storage tank. The telemetry system was installed after the booster station was complete, when it was discovered the tank level was needed to control the finish booster station pumps at the

water treatment plant. Pine street tank water levels are currently monitored with a hydraulic connection through a copper tube to a pressure

transducer that sends a signal through a phone line to the water treatment plant.

4.3.3 Regis Street Booster Station

The Regis Street booster station was constructed in 1972 and is located adjacent to the Regis Tank. The booster station includes two 15-hp pumps and a gas-powered 40-hp fire pump.

There are three pumps in the booster station, including two production pumps and one fire pump. The production pumps are 15 hp horizontal frame-mounted pumps with suction and discharge piping from the floor to 3-foot high concrete pedestals where the pumps are mounted above the floor. The production pumps supply water to the upper pressure service area.



The fire pump is a combination electric/gas pump. The fire pump is a horizontal split-case centrifugal pump with prime mover input shaft on both ends. An electric motor drives one end and a gas engine drives the other end. The discharge of the fire pump goes through a Cla-Val pump control valve into the discharge manifold of the production pumps.

All the pumps in the booster station operate with mercury pressure switches that control the on/off operation of the pumps. The fire pump starts automatically (electric drive only) on low pressure in the system. The gas-driven engine is a manual start only and has to be engaged to drive the pump. The engine for the fire pump is an old International Harvester gas engine. City personnel have had problems acquiring parts for engine maintenance and repair. The engine is long since out of production, and parts are hard to find.

The cooling system for the gas engine is a heat exchanger, with cooling water provided from the municipal water supply. The cooling water is turned on manually and passes through the engine once and then is discharged to waste.

One of the 15 hp demand booster pumps runs continuously in order to maintain pressures in the upper pressure service area. The system was set up years ago for continuous operation, and it continues to work that way today. As a result, water bleeds from the upper to the lower pressure



zone continuously to equalize the pressures. The electrical components of the Regis booster station are old and outdated.

Controls. The motor control system is of a 1970's-vintage and has an incoming power main disconnect and main control modules. The MCC has been tested for wiring problems and heat generation, but has not exhibited any problems yet. The motor control system seems to be working adequately at this time.

Near the MCC is a radio telemetry system that was installed years ago. The system never worked, so it was abandoned. If the system has any rework in the future, the control system should be changed to provide control through a programmed SCADA system.

4.4 Distribution System

This section outlines the pipe materials, pipe conditions, meter conditions, and valve and fire hydrant needs. A hydraulic analysis of the distribution system is presented in Section 5 of this report.

The City's water distribution system is composed of a network of pipelines totaling more than 44 miles, and ranging from 1 to 24 inches in diameter. The majority of the pipeline network consists of 6-inch lines, with the most prevalent pipe materials being asbestos cement and ductile iron, as illustrated in the following tables. Table 4.1 lists the length of pipe and percent of total for each pipe size.

Table 4.1
Water Distribution Pipe Size Summary

Pipe Size (in)	Total Length (ft)	% of Total
<= 2	28,537	12%
3	3,825	2%
4	28,227	12%
6	56,377	24%
8	39,524	17%
10	26,589	11%
12	26,664	11%
14	713	0.3%
16	9,213	4%
18	3,696	2%
20	8,977	4%
24	522	0.2%
Total	232,864 feet	44 miles



The water distribution system is composed of various pipe materials as shown in Table 4.2.

Table 4.2
Water Distribution Pipe Material Summary

Pipe Type	Total Length (ft)	% of Total
Asbestos Cement	85,928	37%
Cast Iron	1,404	1%
Ductile Iron	72,146	31%
Galvanized Iron	10,320	4%
PVC	15,818	7%
Steel	47,076	20%
Total	232,864 feet	44 miles

Figure 4.1 in Appendix A illustrates the waterline network and the location of the reservoirs, and pressure-reducing valves (PRVs). The water booster stations and transmission lines provide water service to pressure zones that are isolated by closed valves and PRVs.

The distribution network consists of two pressure service areas. The upper service zone generally encompasses the area north of Jefferson Street and east of 6th Avenue. The Regis and Pine Street booster stations pressurize this zone, with pressures typically between 44 and 105 psi. Pressure-reducing valves, as shown in Figure 5.1, allow flow from the upper to the lower zone in the event of pressure loss in the lower pressure service area.

The lower pressure zone serves the majority of the city, including downtown Stayton. The 5.0 MG Pine Street reservoir, the 0.4 MG Regis reservoir, and the finish booster station located at the WTP provide the storage and pressure for this zone. Typical pressures in this zone range from 45 psi to 73 psi. The PRV on 28th Ave. and a check valve on Jefferson Street allow water to flow from the lower to the upper zone in the event of a pressure loss in the upper service area.

4.4.1 Water Meters

The City has had a program in place for the last five years to replace 40 water meters per year. Additionally, Norpac Food's water meters are checked annually. A history of housing development in Stayton is presented in Table 5.3 which was developed from 2000 Census Data. A general correlation exists between the age of the homes and the water meters.

In large part, the housing units are served by their original water meters. This would imply that close to 35% of the water meters are at least 35



years old, 23% are between 25 and 35 years old, 12% are between 15 and 25 years old, and 30% are less than 15 years old.

Table 4.3
History of Housing Development in Stayton

	1970	1980	1990	2000
Total Housing Units	938	1,546	1,867	2,668
Additional Housing Units / Meters	-	608	321	801
Estimated % of Total	35%	23%	12%	30%

Consumers. All city water consumers, excluding those listed below, are metered and billed monthly. Most water services are fitted with a ¾” meter. Currently, the City’s waster system contains 881 touch-read meters and 1,608 manual-read meters. The authorized consumers that are not metered every month fall into two categories: consumers without meters, and consumers with meters that are not read.

Consumers without meters:

- City parks
- WTP
- Cemetery
- City Shops
- Fire hydrant @ Fire Station

Consumers with meters that are not read:

- Public Works Building
- City Hall
- Theatre
- WWTP
- Library
- Police Department
- Pool
- Community Center

The City plans to install water meters for the consumers without meters within the next three years. The City intends to read all water connections, including those listed above, monthly whether or not they are invoiced. This information will be important for future water audits.

4.5 Water Valves and Fire Hydrants

The City’s base mapping was updated as part of this project. Each water valve and hydrant was GPS located. The age of the valves and fire hydrants generally corresponds to the age of the adjacent water lines.



The City has approximately 1,120 water valves and 370 fire hydrants. There are approximately 50 double-port hydrants and 320 triple-port fire hydrants. The triple-port hydrant is equipped with a steamer port. The City has historically conducted an annual flushing program to clean the water lines as well as inspect fire hydrant performance.



SECTION 5 - ANALYSIS

5.1 Hydraulic Model

Haestad Methods' WaterCAD v6.5 was used to create the hydraulic model of the City of Stayton water distribution, storage and delivery system. The software applies the Hazen-Williams formula in an iterative manner for complex networks to determine system pressures based on various flow scenarios. The software also has the ability to determine fire flows available to each node by systematically analyzing each node (pipe junction) at different flow rates, and checking every other node to determine the maximum amount of water available without drawing the pressure levels below 20 psi at any node in the system.

Information regarding pipe diameters, network connectivity, and material types were determined through available mapping and consultations with City staff familiar with the water system. Demands (flows) were distributed based on number of estimated Equivalent Residential Units (ERUs), and water consumption billing records for the top users in the City.

5.2 Model Calibration

Model calibration refers to the process of adjusting model parameters, such as pipe roughness, so that model outputs match observed field conditions. For this study, fire hydrant flow tests served as the basis for model calibration.

A series of 14 tests were conducted in 2003 (tests #1-6 on July 30, tests #7-13 on Nov. 19, test # 14 on Dec. 15), and one was conducted in 2004 (test #15 on Feb. 15). Static and residual pressures (i.e. pressures before and during the fire tests) and flows were recorded. System conditions at Pine, Regis, and the finish booster stations, and at the reservoirs and water treatment plant (WTP) were also recorded using the City's SCADA system and personnel. A table with these recorded boundary conditions and fire flow test results is included in Appendix C.

A comparison of model versus field pressures was conducted to determine the accuracy of the model in replicating the water system conditions. Table 5.1 shows the result of the comparison between the field observed values and the model results. The "error" column represents the pressure difference between the field measurement and the model result. The test locations designated in the table are shown on Figure 5.1.

The calibration resulted in a model that reflects the actual conditions of the water system. For 88% of the tests, the error was less than or equal to 3 psi. This illustrates that the water model is well calibrated and will serve as an excellent tool for evaluation and planning in Stayton.



Table 5.1
Fire Hydrant Calibration Results

Test No.	Location	FH Flow (gpm)	Field Observed			Model Results			Error (psi)
			Static (psi)	Residual (psi)	Diff (psi)	Static (psi)	Residual (psi)	Diff (psi)	
1	1A	490	69	48	21	72	53	19	2
	1B		58	39	19	58	39	19	0
	1C		72	52	20	76	57	19	1
2	2A	1290	60	46	14	62	49	13	1
	2B		58	56	2	63	60	3	-1
3	3A	1560	67	55	12	71	58	13	-1
	3B		66	58	8	70	62	8	0
4	4A	1500	64	56	8	68	60	8	0
	4B		64	55	9	67	58	9	0
5	5A	1700	68	61	7	72	65	7	0
	5B		67	62	5	70	65	5	0
6	6A	600	66	56	10	68	59	9	1
7	7A	450	74	40	34	72	41	31	3
	7B		60	40	20	60	39	21	-1
	7C		60	40	20	60	40	20	0
	7D		78	38-44	38	74	43	31	7
8	8A	550	92	40	52	92	40	52	0
	8B		86	34	52	85	32	53	-1
	8C		61	39	22	60	40	20	2
	8D		78	30	48	74	34	40	8
9	9A	700	58	58	0	59	59	0	0
	9B		57	56	1	59	58	1	0
	9C		58	57	1	58	57	1	0
10	10A	1600	58	56	2	59	56	3	-1
	10B		57	55	2	59	58	1	1
	10C		58	52	6	58	54	4	2
11	11A	626	60	58	2	61	59	2	0
	11B		60	57	3	62	58	4	-1
12	12A	950	60	57	3	61	56	5	-2
	12B		60	56	4	62	55	7	-3
13	13A	1400	57	50	7	59	56	3	4
	13B		58	54	4	57	53	4	0
14	14A	600	92	68	24	98	67	31	-7
	14B		95	65	30	95	65	30	0
	14C		62	46	16	61	43	18	-2
	14D		70	34	36	70	43	27	9
	14E		75	34-42	35	74	41	33	2
15	15A	860	64	32	32	66	37	29	3
	15B		65	35	30	66	36	30	0
	15C		66	52	14	67	52	15	-1
	15D		64	63	1	66	64	2	-1



As part of the calibration process, Keller Associates and City personnel were able to identify areas where the model was not matching up with field observations. Further investigation identified two locations where closed valves or incorrect mapping data reduced the fire protection in the area. This type of discovery highlights the usefulness and utility of a water model.

Actual demands at the time of the fire hydrant tests, inaccuracy in gauge and pitot (hydrant flow) measurements and small variations in system boundary conditions are believed to account for most of the discrepancies between the actual pressures and the model results. Partially closed valves and inaccurate as-built data may also result in discrepancies between model and field results.

5.3 Existing Distribution System Hydraulic Evaluation

The model was used to simulate the existing Stayton water system based on 2003 peak day, peak hour and average summer and winter day demand scenarios.

It was determined that the existing distribution system was capable of delivering 2003 peak hour demands with moderate effect on system pressures. Under these conditions, the pressures in the upper zone range from 44 psi near the higher elevations to 105 psi along E. Santiam Street. Typical pressures in the lower zone range from a high of 73 psi in the southwest corner of town, down to 35 psi near the corner of Shaff Road and 1st Avenue.

The distribution system was also evaluated using WaterCAD to determine available fire protection throughout the service area, with a minimum system pressure of 20 psi during a fire event. The minimum fire flow assumed for residential areas was 1,000 gpm. Larger buildings (such as the Stayton High School, Regis High School, Junior High School, and the hospital) may require fire flows as high as 4,500 gpm for a duration of 4 hours, depending on size, construction material type, and if the buildings are equipped with sprinklers. Buildings such as the schools, which use more than one hydrant, were evaluated separately, using each of the fire hydrants available to provide fire protection.

The areas that are lacking fire protection are illustrated in Figure 5.2 in Appendix A. This figure highlights the areas that do not meet the 1,000 gpm minimum residential requirement or the fire flow necessary for other commercial and public facilities. The amount of available fire flow is shown in these areas.

Some of the areas indicated in Figure 5.2 lack adequate fire protection because the fire hydrants are served by 4-inch lines. Other areas shaded in yellow either have undersized pipes or are public facilities or commercial zones requiring greater fire protection than the existing pipelines can deliver. Recommended improvements to address these inadequacies are discussed further in the following section.



5.3.1 Future Distribution Conditions

The existing distribution system was also evaluated to determine if the existing water mains were capable of delivering future peak hour demands plus fire protection in the City and the areas of future development. The projected year 2025 population of 15,000, and build-out of the urban growth area as determined by the City were used to evaluate the future needs and conditions of the distribution system. To handle build-out densities, a grid with 12-inch water mains and 10-inch water mains is recommended. Section 7 of this report discusses the recommended improvements that will provide adequate water distribution, storage and pressures for the future conditions of Stayton.

5.4 Distribution Water Quality

Water quality modeling of the distribution system was not completed as part of this study. However, according to City staff, water quality tasting routinely confirms that chlorine residuals are maintained throughout the distribution system with winter time low residuals observed at Pine Street tank. Figure 5.3 illustrates 2005 water quality sampling.

5.5 Water Storage Needs

The City of Stayton has four finish water storage facilities with a combined storage volume of 6.9 million gallons (MG). The following table summarizes the reservoir data.

Table 5.2
City of Stayton Storage Reservoirs

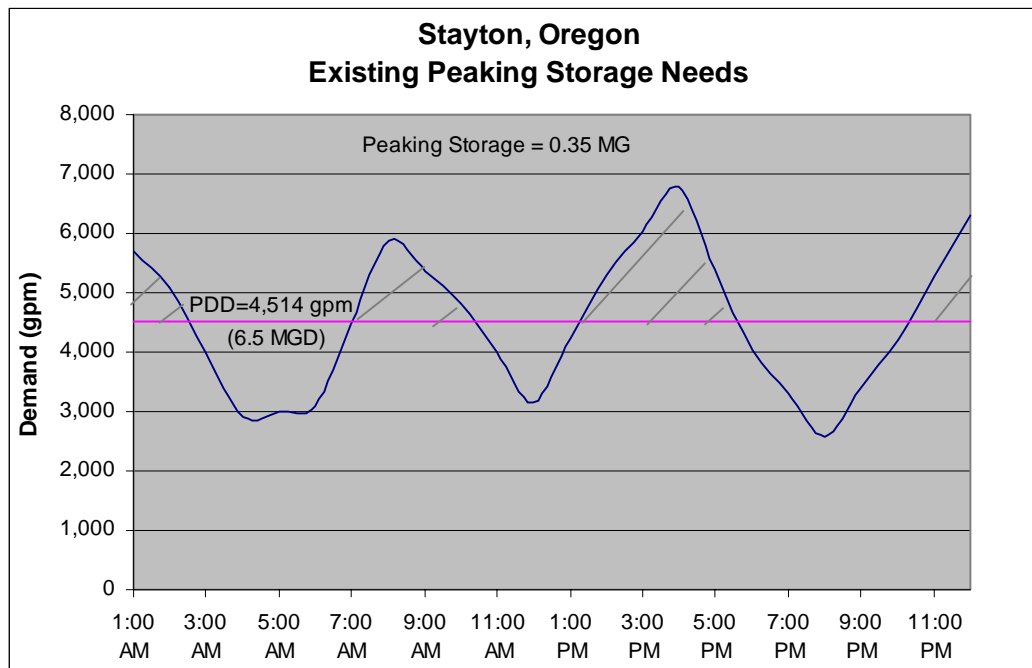
Reservoir	Construction Type	Diameter (ft)	Height (ft)	Constructed/ Rehabilitated	Volume (MG)
Schedule "M"	Bolted Steel	65	40	1970	1.0
Pine Street	Concrete	148	40	1995	5.0
WTP Clear Well	Welded Steel	53	30	1971	0.5
Regis	Welded Steel	31	80	1971	0.4
Total Finish Water Storage					6.9 MG
Raw Water Storage in Existing Filter Beds					2.7
Total Water Storage					9.6 MG

Storage is designed to provide fire protection demand plus operational and peaking (daily peaking demand) storage. The fire protection storage, as stipulated by the International Fire Code, was calculated by assuming a four-hour fire event with a demand of 4500 GPM. This correlates to fire storage of 1.08 MG. Operational storage is the volume of water between the pump "on" and "off" setting, which for Stayton equates to 15% of existing storage or 1.04 MG. Peaking storage is developed based on a local demand pattern which represents



the variation in hourly demand. The 24-hour demand pattern in Chart 5.1 was generated based on 24-hour monitoring data gathered on August 22, 2003.

Chart 5.1
Existing Peaking Storage Needs



Based on the data and the assumptions outlined above, the estimated storage needs for 2003, 2015, 2025, and build-out are as presented in Table 5.3. A comparison of the minimum recommended storage vs. existing storage suggests the City has adequate storage both now and into the future to meet minimum storage requirements.

The City would also like to provide three days of storage to meet other emergency situations such as failure of the WTP, contamination of the surface water source, or other natural disasters that would restrict the City's ability to supply water. This storage would be in addition to the minimum recommended storage. However, during an emergency of this magnitude, water consumption would be curtailed such that residential demands would be minimized and industrial water demands would be restricted. The Storage Goal section of Table 5.3 illustrates the additional storage needed to provide a 3-day backup storage with and without the storage in the filters. If the water in the filter beds is included, the City would essentially have a 3-day storage for the next 10 years.



Table 5.3
Storage Requirements and Goals

Storage Requirements	2003 (MG)	2015 (MG)	2025 (MG)	Build-out (MG)
Population	7,300	10,800	15,000	19,200
Peaking Storage ¹	0.35	0.44	0.56	0.67
Operating Storage ²	1.04	1.04	1.04	1.04
Fire Storage ³	1.08	1.08	1.08	1.08
Minimum Recommended Storage	2.47	2.56	2.68	2.79
Needed Storage	-	-	-	-
Storage Available for Emergencies (Total Storage less Minimum Recommended Storage)				
Existing Storage w/o Filters ⁴	4.43	4.34	4.22	4.11
<i>Including Filters⁴</i>	7.13	7.04	6.92	6.81
Comparisons to:				
Average Wet Weather Demand	1.65	2.21	2.88	3.55
Average Dry Weather Demand	3.75	4.70	5.83	6.96
Annual Average Day Demand	2.70	3.45	4.33	5.21
Norpac Average Annual Demand	0.9	0.9	0.9	0.9
Storage Goal -- 3 Days Average Day Demand with Complete WTP Shutdown				
Desired 3-Day Emergency Storage ⁵	5.4	7.6	10.3	12.9
Less Available Emergency Storage ⁶	(4.43)	(4.34)	(4.22)	(4.11)
Storage Need Without Filter Beds⁷	0.97	3.30	6.06	8.82
Storage Need With Filter Beds⁷	-	0.60	3.36	6.12
Equivalent 3-Day Well Capacity (MGD)	0.32	1.10	2.02	2.94
Equivalent 3-Day Well Capacity (GPM)	220	760	1400	2040

Notes

1. Calculated peaking storage using observed 24-hour demand pattern (8/22/2003) and assumes constant production equal to the peak day demand (PDD).
2. Assumed approximately 15% of existing storage to allow for volume between "on" and "off" set points.
3. Assumed a 4-hr 4500 gpm fire event.
4. The city also has approximately 2.7 MG of additional storage in the filter beds.
5. Assumed average day demand without Norpac.
6. Filter bed storage not included, all existing available emergency storage included.
7. This assumes complete autonomy -- no supply from Salem or Sublimity.



One alternative to acquiring additional storage to provide redundancy in the event of a WTP failure or surface water contamination is to construct a municipal well. This alternative would provide a water source independent of surface water behavior. The table illustrates the necessary capacity of the well to meet water demands now and in the future. Another alternative may involve constructing an inter-tie with the City of Sublimity. The City of Sublimity has a groundwater supply, so the benefits would be similar to a municipal well.

Recommended Storage to Meet City Goals and Emergency Storage. No additional storage is required within the projected 20-year horizon. However, additional storage may be desired to achieve the City's goal for providing 3 days of emergency water storage. Keller Associates recommends that the City reevaluate storage needs and City goals around 2015, prior to taking Regis tank off-line (2025) and prior to constructing additional storage. For planning purposes, a future 5.0 MG concrete tank was assumed to be constructed sometime between 2020 and 2025 adjacent to the Pine Street Reservoir.

5.5.1 Average Tank Residence Times

Average residence times during winter and summer months have been calculated with the aid of the water model. The average residence times for each reservoir are presented in Table 5.4.

Table 5.4
Season Average Residence Times

Tank	Winter	Summer
Schedule "M"	20+ days	8 days
Pine	23 days	7.5 days
Regis	23 days	23 days

It can be seen that during the winter months when the water demand is low, the average residence times in all three reservoirs increase substantially. High residence times leads to water stagnation and poor water quality.

Another factor that contributes to the long residence times in the Regis tank is the pipe and valve arrangements. The piping and valve arrangement at the Regis allows water pumped through the Regis booster station to bypass the tank. The Regis booster station can pump water directly from the distribution system in the lower pressure zone rather than from the Regis tank. This leads to high residence times and poorer water quality at the Regis tank. The simplest solution to shortening residence times and improving water quality is to increase the operational storage to include 15% of the total volume.



5.6 Water System Staffing Evaluation

The City's water system consists of the following main components:

- Four water storage reservoirs
- Four booster pumping stations
- A slow sand filter water treatment plant
- Approximately 44 miles of water distribution pipelines, valves, fire hydrants, and water services

Each of the system elements have differing O & M requirements which are discussed further below.

5.6.1 Water Storage Reservoirs

Three of the water storage reservoirs are of steel construction and one of prestressed concrete construction. Operation and maintenance requirements consists of:

- **Steel Tank Painting.** This is normally required approximately every 15-20 years and should be contracted out to a painting contractor with the necessary expertise and safety equipment.
- **Reservoir Inspection and Cleaning.** Each tank should be drained approximately every 5 years and any sediment flushed from the tank. The interior and exterior should be inspected for signs of coating wear, cracking (concrete tank), foundation settlement, and appurtenances such as ladder, overflow, inlet and outlet piping, valves, etc. should be checked for any abnormalities.
- **Routine Maintenance.** Checking for leaks and recording of water levels, grounds maintenance, and access security should be performed daily. Leaks should be evaluated for cause and repaired promptly. Most reservoir repair work, due to its specialized nature, should be subcontracted out. Routine reservoir O & M duties should require approximately 2-3 manhours per day.

5.6.2 Booster Pump Station Facilities

The City has four booster pump stations and it has been recommended by Keller Associates that the Schedule M Booster Station eventually be relocated to the WTP site. The pump and drive types and configurations vary at each pump station with sizes ranging from 7.5 to 40 Hp fire pumps. Some of the equipment and electrical/control systems are old and outdated. Each pump station should be inspected daily to insure



equipment is operating properly. Pump and drive equipment not normally used such as fire pumps should be exercised every 2-3 months. Drive and pump equipment should be regularly lubricated. Minor repairs can be made by City staff with major repairs subcontracted out. An average of ½ manday should be allowed for O & M of the booster stations.

5.6.3 Water Treatment Plant

The water treatment plant is the key component of the City's water system and should be continuously monitored to insure production of a high quality safe drinking water that meets Oregon Department of Health Services requirements. The plant consists of the following primary components.

- Intake screen & pipeline from the North Santiam River to the plant
- Three large slow sand filter basins and distribution facilities
- Chemical dosing facilities for pH adjustment and disinfection
- Clearwell storage and treated water booster pumps
- Monitoring and control equipment
- Lab analysis equipment

Work tasks at the plant include cleaning of the intake screen, periodic removal and replacement of the filter bed surface sand layer, changing of chemical supplies, monitoring of turbidity and water quality analysis, maintenance and repair of equipment, and grounds maintenance. Due to the importance of this facility it is recommended that at least two operators be continuously assigned to the plant from 6:00 am to 8:00 pm with overlapping shifts.

5.6.4 Water Distribution System Facilities

The City has over 44 miles of water distribution lines ranging from 1 to 24-inches in diameter. There are also 1120 valves, 370 fire hydrants, and approximately 2500 water meters. Primary duties in operation and maintenance of the water distribution system include:

- Locating and repairing leaks (0.3 person) - Repair of leaks for lines 4-inch and larger is contracted out. The system has a significant leakage problem with an average water loss of 29% over the last three years.
- Service turn on and offs and line locates (1.0 person).
- Annual flushing of the water system to remove sediment from lines and exercise and maintain fire hydrants (0.2 person).



- All system valves should be exercised at least annually to insure they will not freeze up and operate properly when needed (0.2 person).
- Meter reading and bill preparation on a monthly basis (0.5 person including clerk time). This time could be reduced by addition of a remote driveby readout and computer billing system.
- The City also desires to implement a GIS utility tracking system that will require a full-time person with approximately 0.3 of his time allocated to the water system.

5.6.5 Water System

Summarizing the above, Keller Associates recommends the following levels of staffing for the City's water utility:

Facilities	Equivalent Manpower
Water Storage Reservoirs	0.3
Booster Pump Station	0.5
Water Treatment Plant	2.0
Water Distribution System	2.5
Water System Supervisor	<u>1.0</u>
TOTAL STAFF	6.3

The City's 2005 budget for the water system included funding for 5.3 people including clerks and not including the GIS work which has not yet been implemented. Therefore, it appears the water utility has duties requiring 6.0 personnel (excluding GIS work), and is slightly understaffed if all personnel funded to the water utility actually performed only water utility work. However, in many cases the water utility staff also spend significant time assisting with roads, sewer, and parks and recreation work, which take away from time that should be used for performing water utility functions. It is recommended that the equivalent of 6.3 water utility staff be dedicated to future water utility duties.



SECTION 6 - DEVELOPMENT AND EVALUATION OF ALTERNATIVES

6.1 General

The following discussion outlines the options for water storage and distribution improvements in both the upper and lower pressure service areas to meet current needs and accommodate future development, including build-out within the UGB.

6.2 Water Storage and Booster Stations

The existing reservoir facilities provide 6.9 MG of storage capacity, which is adequate to meet the City's storage needs for the next 20 years. The discussion below addresses future alternative improvements for the three reservoirs and associated booster stations. These alternatives were evaluated with the technical review committee (TRC) in September 2004. Subsequent to this initial evaluation, tracer studies completed at the water treatment plant (WTP) clear well facility demonstrated that existing contact times are woefully inadequate and that immediate baffling would be necessary.

6.2.1 Schedule "M"

Schedule "M" has long residence times, which creates stagnant water conditions. Pipeline improvements, water looping projects and the completion of the Pine Street reservoir have marginalized any fire protection benefit provided by the Schedule "M" reservoir. Redundancy is the primary contribution Schedule "M" makes to the City's water system.

Based on water model results, the absence of the Schedule "M" tank and booster station has very little impact on system pressures. Although there is a slight (200-300 GPM) reduction in fire protection in the east part of town, those areas would still have adequate fire protection.

Four alternatives were developed in conjunction with the TRC to improve the utility of the Schedule "M" reservoir. These alternatives are illustrated in Figure 6.1 in Appendix A, and are discussed in detail below.

Alternative A-Convert Schedule "M" to Clear Well. One alternative to maximize the utility of Schedule "M" is to leave it at its current location but convert it to clear well storage. The following improvements would be necessary to make this alternative possible:

- Construct a large (16-inch) diameter low pressure transmission line from the WTP to Schedule "M".



- New transmission line could potentially be constructed inside Salem’s existing water line easement to offset costs.
- Yard piping improvements at the WTP would be necessary.
- Upgrade pumps at WTP to deliver flow to the Schedule “M”.
- Upgrade Schedule “M” tank by separating the inlet and outlet pipe to improve circulation, and installing baffling.
- Upgrade the electrical and SCADA for the Schedule “M” booster station.

Estimated Project Cost for these improvements = \$973,000.

This alternative would provide the following benefits:

- Redundancy in clear well storage capacity allows either clear well to be taken offline and maintained without pause in water supply.
- Redundancy in finish booster station pumping facilities.
- The diesel-powered pump at Schedule “M” can provide flow to system during power outage, thereby delaying the need for standby power at the WTP.
- The existing Salem inter-tie would continue to service Stayton as an emergency supply.
- Improved circulation in Schedule “M” and regular exercise of pumping facilities.
- Additional clear well capacity may allow for reduced chlorine dosages, depending on needed chlorine residuals.
- Adequate pumping capacity for build-out demands with redundancy.

This alternative would have the following drawbacks:

- High capital cost.
- Additional O&M Costs associated with maintaining two clear wells and two finish pump stations.



Alternative B-Relocate Schedule “M” to WTP. Another alternative to maximize the utility of Schedule “M” is to relocate the Schedule “M” reservoir to the WTP site, and convert it to clear well storage. The booster station and inter-tie at the Schedule “M” site would be abandoned, and a new inter-tie with Salem would be constructed at the WTP site. The following improvements would be necessary to make this alternative possible:

- Dismantle and haul the reservoir to the WTP site.
- Modify yard piping and valves as necessary to deliver flow to the Schedule “M” tank.
- Upgrade Schedule “M” by separating the inlet and outlet pipe to improve circulation, and install baffling.
- Construct a new inter-tie to the Salem pipeline at the WTP site.
- Install standby power at the finish booster station. This is something that is recommended for the WTP regardless of the alternative improvements. Therefore, this cost is not included in the Project Cost. Costs for standby power will be presented in the *Water Treatment Plant Master Plan Report*.

Estimated Project Cost for these improvements = \$510,000.

This alternative would provide the following benefits:

- Eliminates need to construct the transmission line to Schedule “M” (required under Alternative A).
- Relocating tank is less expensive than constructing a new tank.
- Redundancy in clear well storage capacity such that either clear well could be taken offline and maintained without pause in water supply.
- Schedule “M” booster facility could be phased out, thus eliminating capital and O&M costs associated with this facility. A single finish booster station could be used for water supply and the emergency inter-tie with Salem.
- Additional clear well capacity may allow for reduced chlorine dosages, depending on chlorine residuals (O&M Savings).

This alternative would have the following drawbacks:



- High capital cost.
- No redundancy in finish booster stations. The reliability of the Salem inter-tie would be dependent on the operation of the finish booster station unless standby power is installed at the WTP.

Alternative C-Keep Schedule “M” Online, Expand Clearwell at WTP.

Another alternative is to simply maintain the Schedule “M” reservoir and booster station as is (status quo). Baffles would be required at the existing clear well reservoir at the WTP to provide the necessary contact time. The following improvements would be necessary to make this alternative possible:

- Equip the clear well reservoir at the WTP with baffles to increase contact time. This was completed in December 2004.
- Upgrade the electrical and SCADA system for the Schedule “M” booster station.
- Add another clear well at WTP by 2009.

Estimated Project Cost for these improvements = \$1,151,000.

This alternative would provide the following benefits:

- The diesel-powered pump at Schedule “M” can provide flow to system during power outage.
- The existing Salem inter-tie could be used to provide redundancy in water supply if the WTP is offline.

This alternative would have the following drawbacks:

- High capital costs.
- Additional improvements to the clear well reservoir would likely be necessary for build-out contact time.
- Additional O&M costs associated with maintaining Schedule “M” booster station and reservoir.
- Continued wasting of 30 GPM of water required to maintain circulation through the tank.

Alternative D-Abandon Schedule “M” and Expand Clearwell Storage at WTP. Under this alternative, the Schedule “M” tank and booster



station would be abandoned. Additional clearwell storage will be required at the WTP by 2009, and the Salem inter-tie would need to be relocated to the WTP. The following improvements would be necessary to make this alternative possible:

- Equip the clear well reservoir at the WTP with baffles to increase contact time (completed in December 2004).
- Relocate the Salem emergency inter-tie to the WTP site.
- Install standby power at the finish booster station. (This is recommended for the WTP regardless of the alternative improvements. Therefore, this cost is not included in the Estimated Project Cost. Costs for standby power will be presented in the Water Treatment Plant Master Plan Report).

Estimated Project Cost for these improvements = \$1,061,000.

This alternative would provide the following benefits:

- Schedule “M” booster facility would be phased out, thus eliminating capital and O&M costs associated with this facility. A single finish booster station could be used for water supply and the emergency inter-tie with Salem.
- Schedule “M” reservoir would be abandoned, thus eliminating O&M costs for maintenance, painting, inspection, operation, etc.

This alternative would have the following drawbacks:

- High capital costs.
- Increased dependency on finished pump station for supply to City water system.

Recommended Alternative

Keller Associates acknowledges the need for installing baffles in the existing clearwell, (completed December 2004) and recommends the following:

- No electrical upgrades at Schedule “M” – not needed once we have new inter-tie and standby power at WTP.
- Construction of a new inter-tie at the WTP as part of the new Salem pipeline project.



- Completion of Standby Power at the WTP.
- Relocation of Schedule “M” tank to the WTP site.

The alternative provides the City redundancy in its water supply options. Costs for these improvements are outlined in more detail in the *Water Treatment Plant Analysis* report.

6.2.2 Upper Pressure Zone Alternatives – Delivery and Storage

The peak hour water demands in the upper pressure service are expected to grow from approximately 500 GPM in 2003 to 1,815 GPM at build-out.

There are some improvements that will be necessary to correct existing fire flow and operation deficiencies in the upper pressure zone. Since these improvements are needed regardless of what else is done, their cost is not included in the cost comparisons for various alternatives considered. These improvements include the following:

- Upsize the 4-inch water lines on Pine Street, Mt. Jefferson Drive, Highland Drive, and Scenic View Drive with 12-inch lines.
- Upsize the water line on Cedar Ave. to an 8-inch line.
- Install a pressure-reducing valve near the intersection of Hollister Street and 6th Avenue, and construct the adjacent 8-inch water lines as shown.
- Construct a 12-inch water line along 10th Avenue that connects the existing 12-inch dry water line on 10th Avenue to Pine Street, and add another water service to the Hospital from the 6-inch water line that runs west of the Hospital.
- Replace the 4-inch lines on E. Santiam Street, 10th Avenue, and Jefferson Street with 8-inch lines.
- Replace the 6-inch water line from Highland Drive to Stayton Place on E. Santiam Street with a 12-inch water line.
- Upgrade the Pine Street Booster Station to allow control for the upper pressure zone to be transferred from Regis to Pine. Upgrades should include the following:
 - Replace the existing submersible pumps with turbine pumps.



- Upgrade existing pressure tank controls and air compressor system.
- Add standby power connection/hookup capabilities.
- Install a new flow meter.

All these improvements, along with their related costs, are included as part of the recommended plan in Section 7.

Impacts of Regis Booster Station to the Upper Pressure Service Area.

Although the Regis tank has minimal impact on fire protection and existing peak hour static pressures, the Regis booster station does play a modest role in both the fire protection and peak hour static pressures for the upper pressure service area. If the Regis booster station is taken offline, the existing fire protection drops in some places as much as 1400 GPM (illustrated in Appendix D). Many areas, including the mobile home park on Fern Ridge Road, would not have adequate fire protection. In addition, pressures during peak hour demand periods would drop by as much 20 psi, with pressures as low as 39 psi in some places.

The available fire protection to the upper pressure service area will depend on the capacity of the pumps installed at the Pine booster station. However, the transmission lines should be capable of distributing necessary fire protection to the upper pressure service area with the priority improvements and Regis booster station offline. The Regis booster station can not be taken offline without transmission line improvements.

Given the considerations outlined above, a number of alternatives are presented below that will enable the City to meet the growing water demands in the upper pressure service area and enhance the utility of the City's existing facilities including the Pine and Regis tanks and booster stations. These alternatives are illustrated in Figure 6.2 in Appendix A.

Alternative A-Maintain Status Quo at Regis Tank and Booster Station.

This alternative is to maintain the status quo, which includes continuous pumping at Regis booster station with Pine Street booster station used to supplement demands as needed. The existing pumping capabilities in both Regis and Pine Street booster stations could meet the projected water demands and fire protection requirements for the upper pressure zone for 20 years and beyond, even with the fire pump at Regis offline. (At build-out, with the current capabilities, there would be a reduction in pressures during peak hour demand periods of approximately



10 psi in the upper pressure zone.) This alternative involves the following:

- Upgrade the Regis booster station including the electrical, pumps, and SCADA.

Estimated Project Cost for these improvements = \$234,000.

This alternative would provide the following benefits:

- Redundancy—Either Pine Street or Regis booster facilities could be used as primary supply to upper pressure zone.
- Provides necessary fire protection and static pressures now and for the next 20 to 40 years.
- Relatively low cost.

This alternative would have the following drawbacks:

- Additional O&M costs associated with upgrading and maintaining the Regis booster station.
- Additional operation and maintenance costs associated with maintaining two booster stations.
- Requires continuous pumping.

Alternative B-Abandon Regis Tank and Booster. Another alternative is to abandon the Regis tank and booster station, and use only the Pine Street booster station to meet water demands. If the Regis tank and booster station are abandoned, the following improvements would need to be completed first to make this alternative possible:

- Construct standby power at the Pine Street booster station for emergency supply in the case of power outage.
- Add additional pumping capacity to the Pine Street booster station to meet future water demands.
- In order to take Pine Street Reservoir offline, one of the finish booster station pumps should be equipped with a variable frequency drive to control the system. This is recommended as a future improvement at the WTP, so the cost has not been included.

Estimated Project Cost for these improvements = \$236,000.

This alternative would provide the following benefits:



- Eliminate the O&M costs for maintaining the old Regis booster facility and tank.
- More efficient operation at Pine versus continuous pumping at Regis.
- Pine Street is better equipped with a few modifications to act as primary control for upper pressure zone.

This alternative would have the following drawbacks:

- No booster station redundancy. If Pine Street Booster Station had to be taken off-line, pressures as low as 10 psi would result.
- No control redundancy for the finish booster station unless it is equipped with a variable frequency drive.
- Reduces emergency storage capacity with Regis tank off-line.
- The cell tower arrangement would no longer be possible if the tank is dismantled.
- Available fire flow and pressures in upper pressure zone not adequate without other improvements.
- Additional pumping capacity at Pine Street booster station would be necessary at an earlier date.

Alternative C-New Bench Reservoir. Another alternative is to construct a new bench reservoir that will serve the upper pressure area and then abandon the Regis tank and booster station. The following would be necessary to make this alternative possible:

- Construct a 0.5 MG reservoir on the bench which would include the following:
 - Property purchase.
 - Site work.
 - SCADA.
 - Chlorine injection facilities.
- Construct 5,500 feet of large diameter (16") transmission line from the new reservoir to the existing line on Fern Ridge Road which would require a highway crossing.
- Abandon the Regis tank and booster station.



- In order to take Pine Street offline, one of the finish booster station pumps should be equipped with a variable frequency drive to control the system (Optional).

Estimated Project Cost for these improvements = \$1,746,000.

This alternative would provide the following benefits:

- Continuous pumping not required to serve upper pressure zone.
- Provides operational and emergency water storage available directly to the upper pressure zone, and additional overall emergency storage for the entire City.
- Eliminate the O&M costs for maintaining the old Regis booster facility and tank.

This alternative would have the following drawbacks:

- Long residence times in the tank and transmission line may result in water quality problems (disinfection byproducts and inadequate chlorine residuals).
- Additional O&M costs to maintain an additional storage facility.
- High capital costs.

Alternative D-Abandon Regis Tank, but Maintain Single Backup Pump at Regis Booster Station. The final alternative is to abandon the Regis tank, but maintain a single pump at the Regis booster station for backup water supply and fire protection to the upper pressure zone. The following improvements would be necessary to make this alternative possible:

- Upgrade the electrical and SCADA at the Regis booster station such that it has one backup pump with VFD capabilities.
- Add additional pumping capacity to the Pine Street booster station to meet future water demands.
- In order to take Pine Street offline, one of the finish booster station pumps should be equipped with a variable frequency drive to control the system (Optional).

Estimated Project Cost for these improvements = \$207,000.

This alternative would provide the following benefits:



- Eventually allow the Regis tank to be abandoned, eliminating the O&M costs for maintaining this tank.
- Pine Street is better equipped with a few modifications to act as primary control for upper pressure zone.
- Lowest cost alternative.
- Maintains dual booster station redundancy for water supply to the upper pressure service area.

This alternative would have the following drawbacks:

- No control redundancy for the finish booster station unless it is equipped with a variable frequency drive.
- Reduces emergency storage capacity.
- If the tank is dismantled, the cell tower arrangement would no longer be possible.
- Available fire flow in lower pressure zone reduced slightly but not consequentially.

Keller Associates **recommends that Alternative D be adopted.** This is the lowest cost alternative, and will meet both the water supply and fire protection needs for the upper pressure service area both now and into the future. The Regis tank can be abandoned when it is most economically advantageous to the City.

6.2.3 Regis Tank versus Transmission Line Alternatives

Impacts of Regis Tank to the Lower Pressure Service Area. As mentioned in Section 4.2.3, pipeline improvements, water looping projects and the completion of the Pine Street reservoir have marginalized the existing fire protection benefit provided by the Regis tank. Furthermore, system operations create long residence times in the tank and stagnant water during the winter. Given the age and condition of the tank, Keller Associates estimates the remaining life of the Regis tank to be approximately 20 years.

Evaluation of the system after 2025 was performed with Regis tank offline. Available fire protection and peak static pressures, with and without the Regis tank, are shown in Appendix D.



As shown in Appendix D, there is very little additional fire protection provided under existing conditions to the lower pressure service area by the Regis tank. Also, there is only a 2 psi drop in the peak hour static pressures in a few locations in town without the tank. Redundancy is the primary contribution Regis reservoir makes to the City's water system. It provides redundant storage capacity and a redundant facility to control the finish booster station if Pine Street is off-line.

While absence of Regis tank makes little difference to existing peak hour pressures, peak hour pressures in the lower pressure service area at build-out of the UGB were as much as 10 psi lower than existing peak hour pressures. Furthermore, if the finish booster station is offline with Pine Street reservoir as the sole source of water, peak hour pressures drop by as much as 35-40 psi. There are sections of town which might have pressures below 20 psi.

Similarly, while the absence of Regis tank makes little difference to existing fire protection, fire protection in the areas around the Regis tank site (including Sylvan Meadows, the commercial corridor on 1st Avenue near Highway 22 and the adjacent assisted living center) decreased at build-out of the UGB by as much as 1500 GPM. The residential areas maintained sufficient fire protection, but the assisted living center and commercial corridor had fire protection between 2000 and 2500 GPM.

Therefore, three alternatives were considered to improve available fire protection and pressures during peak hour demands when the life of Regis tank has expired and demands approach build-out conditions. These alternatives are illustrated in Figure 6.3.

Alternative A-Maintain Status Quo. One alternative is to rely on the existing system as is to provide both fire protection and peak hour pressures. Under this alternative, there would be greater dependence on the single 20-inch transmission that carries water to and from the Pine Street reservoir. Under normal conditions with all the finish booster station pumps in operation and the Pine Street reservoir on-line, peak hour pressures at build-out would be 8-10 psi lower than existing peak hour pressures and available fire protection in the Sylvan Meadows area would drop by 1500 GPM. There would be no additional improvements necessary beyond the improvements identified in Section 7.2.2.

Estimated Project Cost for this alternative = \$0.

This alternative would provide the following benefits:

- Lowest cost alternative.



This alternative would have the following drawbacks:

- During peak demand periods, if the finish booster station is off-line, pressures drop below 20 psi and fire protection in the lower pressure service area essentially vanishes.
- Greater dependence on both the finish booster station and the single 20-inch transmission line to and from the Pine Street reservoir.

Alternative B-Replace Regis Tank. Another alternative is to replace the Regis tank when its life has expired. Under this alternative, peak hour pressures and available fire protection would be similar to existing conditions. If the finish booster station is off-line, the supplemental flow from the new “Regis” tank would meet both peak hour demands and fire protection needs.

It should be noted that the duration of the fire protection provided by the new “Regis” tank would be dependent on the size of the new tank. For example, if the new “Regis” tank is the same size as the existing tank (0.4 MG), the new “Regis” tank may drain in about one hour with a fire demand and the finish booster station offline. The following improvements would be necessary to make this alternative possible:

- Replace the Regis tank (for comparison purposes, it was replaced with a 0.4 MG tank).

Estimated Project Cost for these improvements = \$686,000 with annual O & M of \$6,000 per year.

This alternative would provide the following benefits:

- Replacement of lost emergency water storage when the life of the existing Regis tank expires.
- Less dependence on the finish booster station and transmission line from Pine Street reservoir.
- Provides adequate peak hour pressures and available fire protection

This alternative would have the following drawbacks:

- Additional O&M costs associated with maintaining new “Regis” tank including inspection, painting, ect.



- Still some dependence on a single transmission line to and from Pine Street reservoir.

Alternative C - Construct Parallel 16-inch Loop from Pine Street Reservoir along Fern Ridge Road. Another alternative is to construct about a mile of 16-inch transmission line from the Pine Street Reservoir north to Fern Ridge Road and then west along Fern Ridge Road to the existing 16-inch line just west of 10th Avenue. This transmission line would be a low-pressure line, and would have no services. Approximately 2600 feet would be along Fern Ridge Road, which may require asphalt repair.

This alternative provides peak hour pressures and fire protection under normal operating conditions. Even with the finish booster station off-line, peak hour pressures only drop about 15 psi with tolerable lows of about 35 psi. The system can also still provide fire protection that is comparable to existing fire protection. The following improvements would be necessary to make this alternative possible:

- Construct a large (16-inch) diameter low pressure transmission line from the Pine Street Reservoir to the existing 16-inch line just west of 10th Avenue.

Estimated Project Cost for these improvements = \$779,000.

This alternative would provide the following benefits:

- Redundancy in major transmission lines to and from the finish booster station to the Pine Street Reservoir.
- Redundancy in major transmission lines from the Pine Street Reservoir to the distribution system in the event that the finish booster station is offline. Appendix D illustrates the available fire protection and static pressures at build-out of the urban growth boundary under this alternative with the finish booster station offline.
- Low O & M costs.

This alternative would have the following drawbacks:

- The City would construct approximately a mile of 16-inch transmission line with no services.
- Additional O&M Costs associated with maintaining two large transmission lines to and from the Pine Street Reservoir.



Keller Associates **recommends that Alternative C be adopted.** Since this improvement is not necessary until about 2025 when the life of the Regis tank expires, the City can begin collecting money now to offset costs. Furthermore, pipe alignment can be coordinated with development in the area to avoid the need to purchase easements. Finally, this alternative provides the most redundancy to the entire system and will meet peak hour pressure demands and fire protection needs even if the finish booster station is off-line.

6.3 Pressure Zone Alternatives

Currently, the City's water distribution system is divided into two pressure zones that are isolated with closed valves, pressure reducing valves, and check valves. These pressure zones are illustrated in Figure 4.1. Keller Associates evaluated alternative pressure zone configurations to improve service and simplify operation.

The most viable alternative to the current configuration is to convert the upper pressure water lines along Jefferson, E. Santiam, and their side streets to the lower pressure zone. In essence, this would move the boundary between the two pressure zones to the base of the hill. Water model runs were performed to evaluate this alternative. Static pressures in the affected areas would drop by approximately 45 psi. Furthermore, pressures in this area could be as low as 40 psi during peak water demand periods. As a result, Keller Associates recommends that the City maintain the current pressure zone configuration.



SECTION 7 - SUMMARY OF RECOMMENDATIONS

This section summarizes the recommended improvements and associated costs for the water storage and distribution facilities. Future recommendations and potential rate impacts are also discussed.

7.1 Master Plan

Recommended master plan improvements are shown on Figures 7.1 and 7.2. As shown on Figure 7.2, the Master Plan for the City of Stayton includes an expansion of both the upper and lower pressure zone service areas. The yellow shaded area reflects future upper pressure service area. The remainder of the area would be served by the lower pressure service area. The red shaded lines are the highest priority improvements (discussed in further detail in Section 7.3). The blue shaded lines are improvements to be completed in the next 3-5 years. The green lines represent future lines to be installed as development occurs.

7.1.1 Pressure Zones

In order to meet growing demands in both the upper and lower pressure service areas, additional production capacity will be required at both the Finish Booster and the Pine Street Booster stations. The existing pumps at the finish booster station can meet the build-out peak day demands with no redundancy. Additional pumping capacity will be needed to provide redundancy. The current pumping capacity at the Pine Street booster station is approximately 500 GPM. Peak hour demands are expected to increase to approximately 1,825 GPM at build-out, which represents an additional 1,325 gpm of pumping capacity (not including redundancy needs and fire protection).

The master plan also calls for three additional pressure-reducing valves in order to enhance interaction between the two zones in the event of fire or emergency conditions. These three locations are the corner of Fern Ridge Road and 10th Ave., the intersection of 6th Ave. and Hollister Street, and near Hwy 22.

7.1.2 Control Theory

In order to reduce large residence times in the Pine Street and Regis reservoirs, Keller Associates recommends increasing the interval between the ON and OFF water level settings at Pine Street Reservoir. Table 7.1 illustrates the proposed Pine Street control set points. A larger interval between the ON and OFF settings will create better circulation and water quality throughout the system. Reducing tank residence times will improve chlorine residuals throughout the system.



Table 7.1
Controls for Finish Booster Station
Based on Pine Street Reservoir Level

Controls for Finish Booster Station Based on Pine Street Reservoir Level	Tank Level	
	On	Off
<i>Well</i>		
100-hp finish pump	30'	36'
#1 200-hp finish pump	28'	38'
#2 200-hp finish pump	26'	37'

For backup and emergency purposes, the City's SCADA system should be capable of operating the Finish Booster Station using either Pine Street or Regis reservoirs. Additionally, the City should equip one of the finish booster pumps with a variable frequency drive (VFD) prior to abandoning the Regis Tank. This would allow the City to provide continuous water supply during periods when the Pine Street Reservoir is out of service.

7.1.3 Water Storage

Keller Associates does not recommend that the City pursue additional storage at this time. When it becomes cost-prohibitive to maintain the Regis Tank or its life expires (estimated to occur around 2025), it should be abandoned. In order to achieve the City's goal of providing 3 days of emergency storage, the City should consider constructing another storage reservoir near the existing Pine Street reservoir site sometime between 2020 and 2025.

7.1.4 Water Distribution

Recommended improvements are broken into priority illustrated in Figure 7.1 and 7.2 of Appendix A. Priority 1 improvements correct existing transmission and fire flow deficiencies, and should be completed within the next couple of years. Priority 2 improvements are primarily to enhance the existing system, and should be completed within the next three to five years. Future improvements should be driven and largely funded by development.

7.2 Existing System Replacement / Rehabilitation Recommendations

Many of the existing facilities were constructed several decades ago. The City of Stayton needs to take measures to upgrade these facilities to maintain the integrity of the water system. A replacement/rehabilitation program for each component of the water system is presented in the following sections.



7.2.1 Storage Facilities

Tank Inspection. The Schedule “M”, Regis, and Clear Well reservoirs are steel reservoirs. The Schedule “M” and Regis tanks have not been inspected for some time, and are in need of inspection now. Due to the condition and age of these two reservoirs, Keller Associates recommends that these reservoirs be inspected every two to three years. The Pine Street reservoir also has not been inspected since its construction and is due for an internal inspection. Due to its age, construction materials, and condition, Keller Associates recommends that the Pine Street reservoir be inspected every 10 years.

Tank Repainting. All three steel tanks (Regis, Clear Well, and Schedule “M”) need repainting of the exterior and interior. Given the durability of current paint finish products, the interior and exterior of steel tanks should be recoated every 15 years. The Pine Street reservoir is concrete and therefore does not require recoating. No significant maintenance or rehabilitation efforts are anticipated for the Pine Street reservoir during the next 20 years. Repainting of Schedule “M” should be postponed until after it is relocated to the water treatment plant site.

7.2.2 Booster Station Facilities

The Schedule “M” booster station is old and not used regularly. To ensure they will function in the event of an emergency, the pumps and valves should be exercised regularly (every 2-3 months) as long as the booster station is kept in service. Keller Associates recommends that the Schedule “M” booster station eventually be abandoned.

The Regis booster station is also old, and will require substantial improvements to upgrade the electrical and mechanical components. Keller Associates recommends that this booster station be upgraded with a single backup pump to the Pine Street Booster Station.

7.2.3 Leak Detection and Water Line Replacement

The new state regulations require any water suppliers that have a system loss greater than 10% to implement a leak detection program. Regulations further stipulate that any water supplier with a system loss greater than 15% must implement a leak repair or line replacement program to reduce system loss. The City of Stayton falls into both these categories with an average system loss of 29% over the last three years.

The City has discussed performing leak detection on all ductile iron and steel pipes. The City intends to conduct a comprehensive leak detection



study within the next five years. The estimated cost for the leak detection study is \$25,000. Those areas determined to contain the most leaks should be targeted first. To minimize costs, pipeline replacements should be coordinated with street improvements.

Keller Associates recommends the City adopt a water line replacement program in order to maintain the integrity of the water distribution system. The asbestos cement and steel lines have historically been most problematic, and thus should be targeted first. (Figure 4.2 in Appendix A illustrates the pipe types throughout the water system.)

Appendix E includes a detailed analysis of the length of each pipe type and size that will need to be replaced in the next 20 years. Based on this analysis, the City should work towards establishing an annual pipeline replacement budget of \$249,000 per year. Over the next 20+ years, this will allow the City to replace all of the steel, cast iron, and galvanized iron pipes, and approximately 25% of the asbestos cement water lines. In order to minimize road repair inconvenience and expense, pipeline replacement should be coordinated with street improvements.

7.2.4 Water Meters

A water meter testing program can provide direction and priority for the meter replacement program. Old meters can be tested for accuracy. An alert meter reader should be able to spot an under-registering meter by a quick comparison with past readings. The accuracy versus location of the meters can be tracked to determine if a correlation between location and accuracy can be drawn. Those areas with meters that consistently test poorly should be targeted for meter replacement. A set of representative meters in an area can be tested every 5 years to track meter accuracy in an area.

Currently, the City's water system contains 881 touch-read meters and 1,608 manual-read meters. Touch-read meters can be converted to radio-read meters by installing a transmitter on the existing touch-read meter. The City intends to convert the system to a radio-read meter system by implementing the following program.

- Replace all manual-read meters with touch-read meters within the next 10 years. This requires the replacement of approximately 160 meters per year (\$24,000).
- Require all new developments to install radio-read meters.
- Purchase radio-read equipment and software once the City reaches 500 radio-read meters. This equipment costs approximately \$50,000.



- After all manual-read meters have been replaced, convert the touch-read meters to radio-read meters by adding a transmitter to each at a cost of \$145 apiece. If 125 meters are replaced annually at a cost of approximately \$18,000 per year, all touch-read meters could be replaced in 7 years.

In addition, Keller Associates recommends that the City install water meters on any un-metered facilities including the city parks, cemetery, city shop, and water treatment plant within the next 5 years. The estimated cost to install meters on all these facilities is \$68,000.

7.2.5 Fire Hydrants

The City has approximately 370 fire hydrants, of which approximately 50 are double-port hydrants and 320 are triple-port fire hydrants. Keller Associates recommends that the City replace all 50 double-port hydrants in the next 10 years, which represents 5 hydrants per year. Assuming a replacement cost of \$3,000 per hydrant, Keller Associates recommends an annual fire hydrant replacement budget of \$15,000 for the next 10 years. (It should be noted that the fire hydrant replacement program should be coordinated with the pipeline replacement program so as to prevent placing a new hydrant on a 4-inch existing main.)

Keller Associates also recommends that the City conduct an annual flushing program to clean the water lines as well as inspect fire hydrant performance.

7.3 Capital Improvement Plan

The Capital Improvement Plan (CIP) outlines priority improvements necessary to ensure sufficient water and fire service to the City, both now and in the future. The CIP also outlines a meter and pipeline replacement program with an estimated annual budget.

7.3.1 Priority 1 Improvements (2005)

Priority 1 improvements are those improvements necessary to correct inadequate fire protection or replace water lines that have serious maintenance and leakage problems. Upgrades to the Pine Street Booster Station and water services in designated areas have also been included in the Priority 1 improvements.

- **Elwood Street Improvements.** Construct an 8-inch water line in Elwood Street from 3rd Ave. to 6th Ave., north to Hollister and then east to the southwest corner of the Stayton Hospital. The existing smaller diameter



lines along this alignment can be abandoned, and any service lines should be reconnected to the new 8-inch line. The new line will bridge the high and low pressure zones, so a PRV should be installed near the corner of Hollister and 6th Ave., as shown in Figure 7.1. This will improve local fire protection and water looping. The PRV should be equipped with a backflow option to allow flow from the lower zone to enter the high zone in the event of a fire event in the low pressure zone.

- **Community Center Improvements.** Replace the existing 2-inch water line on West Burnett between N. Evergreen and W. Virginia Street with an 8-inch line, and connect to the existing water line near Community Center Complex. This will improve looping and fire protection to Community Center.
- **Kathy Street Improvements.** Construct a new 8-inch water line along E. Kathy Street from Sixth Ave. to the 850 block, and abandon the section of water line along the back of lots on E. Kathy Street. This will simplify access for repairs to the water main, and eliminate damage to the backyards.
- **Maple Avenue Area Improvements.** Replace the undersized water lines on Gardner Ave., Maple Avenue, and Fern Ave. with 8-inch lines to improve fire protection and looping.
- **2nd Ave Improvements.** Replace undersized water line on 2nd Ave. from Burnett Street to Virginia Street and from Hollister Street to Pine Street with an 8-inch line, to improve local fire protection and water looping.
- **Bowling Alley Area Improvements.** Replace the undersized water lines on E. Santiam Street from 10th Ave. to the fire hydrant near the bowling alley, on 10th Ave. from E. Santiam Street to Jefferson Street, and on Jefferson Street from 10th Ave. east to the fire hydrant located about 600 feet away with 8-inch lines. This will improve local fire protection.
- **Locust Road Improvements.** Reconnect the fire hydrants and service lines along Locust Road from Gardner Road to 1st Ave. to the 10-inch water line, and abandon the parallel 4-inch line. This will improve fire protection for the area surrounding the Stayton High School.
- **Florence Street Improvements.** Replace the undersized water line on Florence Street from 3rd Ave. east with an 8-inch line to improve local fire protection.
- **E. Santiam Street Improvements.** Replace the undersized line along E. Santiam Street from 15th Ave. to Stayton Place with a 12-inch water line,



and add a fire hydrant at Scenic View Drive to improve water transmission and fire protection in the upper pressure zone.

- **Pine Street Improvements.** Replace undersized line along Pine Street from 10th Ave. to Mt. Jefferson Drive with a 12-inch water line, to improve water transmission and fire protection in the upper pressure zone.
- **Highland Drive Area Improvements.** To improve local fire protection and extend service to the north, replace the undersized lines north of Pine Street including Mt. Jefferson Drive, Highland Drive, and Scenic View Drive with 8-inch lines.
- **Cedar Street Improvements.** Replace the undersized line on Cedar Street from 6th Ave. west for 250 feet with an 8-inch line to improve fire protection.
- **Safeway Complex Improvements.** Construct an 8-inch water line that will loop from the end of existing water line on Fir Street to water line in Safeway complex, to improve water looping and local fire protection.
- **Shaff Road Improvements.** Construct new 16-inch water line along Shaff Road from east edge of Stayton Middle School to east of Douglas Road. Also replace undersized line along Fern Ave. from Shaff Road to Kathy Street with an 8-inch line. These two improvements will enhance water transmission and local fire protection.
- **Pine Street Booster Station Improvements.** Upgrade the Pine Street Booster Station to allow control for the upper pressure zone to be transferred from Regis to Pine. Upgrades should include the following:
 - Replace the existing submersible pumps with turbine pumps
 - Upgrade existing pressure tank controls and air compressor system
 - Add standby power connection/hookup capabilities
 - Install a new compound flow meter
 - Eliminating need for control “bleeding” of water from upper pressure zone to lower pressure zone
- **Add Valves on Shaff Road**
- **10th Avenue Improvements.** Replace the undersized water lines along 10th Avenue from Fir to Pine Street with a 12-inch water line to improve water transmission and fire protection in the upper pressure zone. To provide redundancy, add another water service to the Hospital Campus that would draw water from the 6-inch water line west of the Hospital.
- **Repaint Interior and Exterior of Regis and Schedule “M” Tanks.**



7.3.2 Priority 2 Improvements (2010)

Priority 2 improvements primarily include water line replacements that will improve water circulation by reducing the number of undersized pipes, increasing water line looping, and eliminating old and decaying water lines. In general, the Priority 2 Improvements are not needed for meeting minimum fire protection requirements, but will improve service, looping, and fire protection.

- **Water Street Improvements.** Reconnect service lines from 2-inch to 16-inch line, and abandon 2-inch parallel line along Water Street.
- **West Ida Street Improvements.** Replace undersized and old piping along Ida Road from Wilco Road to Holly Ave. with 8-inch lines. Also from Holly to Evergreen Ave., reconnect all service lines from the 4-inch to the 16-inch line and abandon the 4-inch line.
- **Marion Street Area Improvements.** Replace undersized lines on Marion Street from 1st Ave. to 2nd Ave. and north to Burnett Street, with an 8-inch line. Also replace undersized lines on Marion Street from 4th Ave. to 7th Ave. and north to Virginia Street with an 8-inch line.
- **Washington Street Improvements.** Replace undersized line along Washington Street from 1st to 3rd Ave. with an 8-inch water line. Also, reconnect service lines from the 4-inch line to the 16-inch line along Washington Street from Evergreen to 3rd Ave., and then abandon the 4-inch line.
- **Robidoux Street Area Improvements.** Replace undersized water lines in the area from Jefferson to Fir Street and from 3rd to 6th Ave. with 8-inch lines.
- **Jefferson Street Improvements.** Replace undersized water lines not previously identified as Priority 1 improvements along Jefferson Street from 6th to 15th Ave. and north to E. Santiam Street with 8-inch lines.
- **Douglas Ave Area Improvements.** Replace undersized water lines between Shaff and Regis Road (including Birch, Douglas, and E. Kathy Street) with 8-inch lines.
- **Birch Ave Area Improvements.** Replace undersized water lines on Birch and Douglas Ave. between Washington Street and Locust Road, with 8-inch lines.



- **Hollister Street Area Improvements.** Replace undersized water lines in the area from Hollister to Cedar Street and 1st Ave. to 3rd Ave. with 8-inch lines.
- **Salem Inter-tie Improvements.** Construct inter-tie with Salem water transmission pipe at the water treatment plant. This will enable the City to ultimately abandon the Schedule “M” Booster Station. The new inter-tie at the WTP could be piped directly to the existing finish booster station pumps.
- **Regis Booster Station.** Upgrade the Regis Booster Station with one reliable emergency pump to provide redundancy for the upper pressure zone.
- **Water Service Improvements.** Water services should be replaced as soon as possible in both the Northslope Subdivision and the Westown Subdivision.
- **Secure Land for Future Tank Site.**

7.3.3 Priority 3 Improvements (2015)

Priority 3 improvements primarily include:

- **Abandon Schedule “M” Booster Station.**
- **Pine Street Capacity Improvements.** Increase the pumping capacity at the Pine Street Booster Station by 1,325 GPM to meet build-out water demands. Also provide VFDs.

7.3.4 Priority 4 Improvements (2025)

Priority 4 improvements primarily include:

- **Fern Ridge Road Improvements.** Construct a parallel 12-inch upper-pressure water line along 10th Ave. from Dawn Drive to Fern Ridge Road, and east along Fern Ridge Road from 10th Ave. to the mobile home park. The existing water line should be converted to a low-pressure line to provide water service to the area north of Fern Ridge Road. A PRV with backflow capabilities should separate the upper and lower pressure zones.
- **Abandon Regis Tank.** Abandon Regis Tank when it becomes cost-prohibitive to maintain, or it has reached the end of its useful life.
- **16-inch Transmission Loop From Pine St.** Construct a 16-inch low pressure transmission line from the Pine Street reservoir to the existing 16-inch water line on Fern Ridge Road.



- **3rd Avenue Future Improvements.** Construct a 16-inch transmission line from the existing 24-inch water line at Water Street to Virginia Street along 3rd Avenue.
- **Construct New Reservoir.** Construct a 5.0 MG reservoir near the existing Pine Street reservoir site.

7.3.5 Future Improvements – Coordinate with Growth and Street Repairs (2010-2025)

Future Improvements are intended to expand the water system to meet future growth. These improvements will be necessary to maintain fire protection and water pressure requirements in the future. As Stayton continues to grow, the following improvements are recommended:

- **Future Pipeline Improvements.** Construct new pipelines needed to extend water service to growth areas as illustrated in Figure 7.2.
- **Small Diameter Pipeline & Looping Projects.** Replace small diameter pipelines and loop water lines wherever possible as part of the pipeline replacement program.
- **Shaff Road Future Improvements.** Extend the 16-inch water line from Middle School to Wilco Road as part of pipe replacement program.
- **Wilco Road Future Improvements.** Construct 16-inch water line from Ida to Shaff Road along Wilco Road as part of pipe replacement program.
- **Construct Mill Creek Booster Station and East Pine Small Booster Station.** (Refer to Figure 7.2). The Mill Creek booster station will be sized to deliver normal operating demands plus fire protection demands to future water users located between Mill Creek and the Santiam Highway. The small booster station proposed to serve the area east of the Pine Street water tank will boost pressures to an acceptable 40 – 80 psi range, and will not need to be capable of pumping fire demands. Instead, fire demands will be provided from the existing booster station via bypass valving to the East Pine Booster service area.

7.3.6 Summary of Costs

Table 7.2 summarizes the water distribution capital improvements by priority.



Table 7.2
Capital Improvement Plan – Water Distribution System
Estimate of Most Probable Cost (2005 Dollars)

Item	Project Costs				
	Priority 1	Priority 2	Priority 3	Priority 4	Future
<u>Priority 1 (2005)</u>					
<i>Pipeline / Distribution Improvements</i>					
• Elwood Street	\$280,000				
• Community Center	86,000				
• Kathy Street	69,000				
• Maple Blvd	208,000				
• 2 nd Ave	58,000				
• Bowling Alley Area	133,000				
• Locust Road	46,000				
• Florence Street	95,000				
• E. Santiam Street	72,000				
• Pine Street	200,000				
• Highland Drive Area	169,000				
• East Ida Road	288,000				
• Cedar Street	29,000				
• Safeway Complex	73,000				
• Shaff Road	341,000				
• Add Valves To Shaff Road	11,000				
• 10 th Ave	75,000				
• Complete Leak Detection Study	25,000				
• Meter Unmetered Facilities	68,000				
• Repaint Interior & Exterior of Regis Tank	135,500				
<i>Booster Station Upgrades</i>					
• Pine St. Booster Station	97,000				
• City Hall	409,200				
Total Priority 1	\$2,967,200				
<u>Priority 2 (2010)</u>					
<i>Pipeline / Distribution Improvements</i>					
• Water Street		\$25,000			
• West Ida Road		235,000			
• Marion Street Area		189,000			
• Washington Street		93,000			
• Robidoux Street Area		378,000			
• Jefferson Street		299,000			
• Douglas Ave Area		261,000			
• Birch Ave Area		92,000			
• Hollister Street Area		123,000			
• Water Service		418,000			
<i>Other Upgrades</i>					
• Regis Booster Station		182,000			
• Install Radio-read Meter System		50,000			
• Salem Inter-tie		58,000			
• Secure Land Tank/Well Site		150,000			
Total Priority 2		\$2,553,000			
<u>Priority 3 (2015)</u>					
• Abandon Schedule "M"			\$29,000		
• Pine Street Add't Capacity w/VFDs			74,000		
Total Priority 3			\$103,000		
<u>Priority 4 (2025)</u>					
• Fern Ridge Road				\$198,000	
• 16-Inch Transmission Loop from Pine Street				779,000	
• Abandon Regis Tank (2025)				\$42,000	
• Construct new 5.0 MG				\$2,862,000	



Storage Reservoir					
• 3 rd Avenue Future – upsize cost				\$37,000	
Total Priority 4				\$3,918,000	
<u>Future—Coordinate w/ Growth & Street Repairs (2010-2025)</u>					
<i>Pipeline / Distribution Improvements</i>					
• Upsize Costs for Future Pipeline					\$990,000
• Shaff Road Future					90,000
• Wilco Road Future					132,000
<i>Other Upgrades</i>					
• East Pine Street Small Booster					130,000
• Mill Creek Booster Station					427,000
TOTAL (rounded)	\$2,967,200	\$2,553,000	\$103,000	\$3,918,000	\$1,769,000

Notes: Costs include engineering and contingencies.
Future Costs are in 2005 dollars.

7.3.7 Additional Annual Budget Considerations

In addition to the capital improvements recommended above, the city of Stayton should begin phasing in additional staffing and replacement programs:

- Additional Operating Staff (\$60,000/year)
- Pipeline Replacement Program (\$249,000/year)
- Meter Replacement Program (\$24,000/year)
- Fire Hydrant Replacement Program (\$15,000/year)

7.3.8 Budget & Rate Impacts

An evaluation of budget and rate impacts of the proposed water distribution and treatment capital improvement plans was completed by Economic and Financial Analysis. As part of this evaluation, priority capital improvements, staffing, and replacement programs were phased over the course of the next 10 years to minimize initial rate impacts. A detailed evaluation can be found in Appendix F of the water distribution facilities planning study. Recommended rate increases are presented in the executive summary.

7.4 System Development Charges

Keller Associates evaluated each improvement to determine which improvements were growth related and which ones were not. Where correcting existing deficiencies also benefits future growth, a portion of the improvement costs have been assessed growth. A detailed evaluation of SDCs was completed by Economic and Financial Analysis and can be found in Appendix G of the Water Distribution Facilities Planning Study.



7.5 Potential Funding Sources

To accommodate the recommended system improvements, a financing program will need to be established that can support implementation of this improvement program. A variety of funding resources exist in both the private and public sector. It is recommended that funding from both sectors be considered. Some of those resources in the public field are listed below.

- **Oregon Department of Environmental Quality (Wastewater-Clean Water State Revolving Fund)**—20 year, 3.6% interest rate loans.
- **Oregon Economics and Community Development Department (Community Development Block Grant Program)**—Availability dependent on the median household income and user rates; Grant funds up to a maximum of \$750,000; Priority given to cities with compliance infractions.
- **U.S. Economic Development Administration**—Grant and loan funds; Priority based on economic development potential.
- **Oregon Economics and Community Development Department (Water/Wastewater Financing Program)**—State funded program (Oregon Lottery); Grant and loan funds generally provided on a 50/50 basis; Grant funds have a maximum of \$750,000; 25-year loan at 4.6+% interest rate; Eligibility based on average household income and compliance issues.
- **Oregon Economics and Community Development Department (Special Public Works Program)**—State funded program (Oregon Lottery); Loan funds only; 25-year loan at 4.6+% interest rate; Eligibility based on average household income and compliance issues.

The State of Oregon holds a One-Stop Meeting monthly at which representatives from the various funding agencies attend. At the One-Stop Meeting, projects are reviewed and the representatives discuss the funding available from their respective agencies. Recommendations about the most appropriate funds or combination of funds are agreed upon as a funding community.

